APPENDIX D

PACE LABORATORY AND MICROSEEPS LABORATORY
QUALITY ASSURANCE PLANS

UNCONTROLLED COPY

QUALITY MANUAL

Quality Assurance/Quality Control
Policies and Procedures

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Effective Date: Date of Last Signature on Main Title Page

This manual is also applicable to the

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Revision: 6.0

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This is / is not a controlled document (control status must be circled before release).

This document, with the necessary addenda, has been accepted as the Quality Assurance Manual.

29 Jul 2002 — Pittsburgh

Laboratory General Manager — Date — Laboratory

7/29/02

Quality Assurance Officer — Date

7/29/02

Technical Director — Date

Technical Director — Date

Technical Director — Date

Technical Director — Date

1.0 INTRODUCTION

1.1 FOREWORD

Pace Analytical Services, Inc. is a privately held, full service environmental testing firm operating a system of laboratories nationwide. Pace Analytical offers extensive services beyond standard environmental testing, including: bioassay for aquatic toxicity, air toxics, industrial hygiene testing, explosives, high resolution mass spectroscopy (of compounds such as dioxins and coplanar PCB's), field services and mobile laboratory capabilities. Pace Analytical has implemented consistent Quality Systems in each of its laboratories. In addition, the company has developed an advanced data management system that is highly efficient and allows for flexible data reporting. Together, these systems insure data reliability and superior on-time performance. This document defines the Quality Systems and QA/QC protocols.

Pace Analytical's goal is to continue to combine its expertise in laboratory operations with customized solutions to meet the specific needs of its clients.

1.2 STATEMENT OF PURPOSE

Our purpose is to meet the business needs of our customers for high quality, cost-effective analytical measurements and services.

1.3 QUALITY POLICY STATEMENT

Pace Analytical is committed to providing the highest quality product to our clients. Data validity and reliability are ensured by adherence to rigorous quality assurance/quality control (QA/QC). Pace Analytical emphasizes the application of sound QA/QC principles beginning with the initial project planning through all field and laboratory activities and, ultimately to the final report generation. Concise data quality principles of representativeness, completeness, comparability, precision and accuracy are applied.

The management of Pace Analytical is committed to quality by providing the resources, including facilities, equipment and personnel to ensure the adherence to these quality assurance/quality control protocols. Pace Analytical's quality assurance policy is based on the definition of quality as conformance to requirements which are governed by Company policies, government regulations and standard operating procedures.

1.4 CORE VALUES

* INTEGRITY
* VALUE EMPLOYEES
* KNOW OUR CUSTOMERS
* HONOR COMMITMENTS
* FLEXIBLE RESPONSE TO DEMAND
* PURSUE OPPORTUNITIES

* CONTINUOUSLY IMPROVE

1.5 CODE OF ETHICS

Pace Analytical's fundamental ethical principles are as follows:

- Each Pace Analytical employee is responsible for the propriety and consequences of his or her actions.
- Each Pace Analytical employee must conduct all aspects of Company business in an ethical and strictly legal manner, and must obey the laws of the United States and of all localities, states and nations where Pace Analytical does business or seeks to do business.
- Each Pace Analytical employee must reflect the highest standards of honesty, integrity and fairness on behalf of the Company with clients, suppliers, the public, and one another.

Strict adherence by each Pace Analytical employee to this Code of Ethics and to the Standards of Conduct is essential to the continued vitality of Pace Analytical.

Failure to comply with the Code of Ethics and Standards of Conduct will result in disciplinary action up to and including termination and referral for civil or criminal prosecution where appropriate. An employee will be notified of an infraction and given an opportunity to explain, as prescribed under current disciplinary procedures.

1.6 TRAINING

Training, including specific elements of this policy, is provided to all newly hired employees and as a refresher to existing staff (refer to Section 3.3).

1.7 STANDARDS OF CONDUCT

Data Integrity

The accuracy and integrity of the analytical results produced at Pace Analytical are the lifeblood of the Company. Lack of data integrity is an assault on our most basic values and puts Pace Analytical and its employees at grave financial and legal risk. Therefore, employees are to accurately prepare and maintain all technical records, scientific notebooks, calculations and data bases. Employees are prohibited from making false entries or misrepresentations of data, dates, calculations, results or conclusions.

Confidentiality

Pace Analytical employees must not (directly or indirectly) use or disclose confidential or proprietary information except when in connection with their duties at Pace Analytical. This is effective over the course of employment and for a period of two years thereafter. Confidential or proprietary information, belonging to either Pace Analytical and/or its clients, includes but is not limited to test results, trade secrets, research and development matters, development, procedures, methods, processes and standards, company-specific techniques and equipment, marketing and client information, inventions, materials composition, etc.

Financial Responsibility

Pace Analytical employees must accurately keep all books, records and accounts for which they are responsible. Employees are responsible for maintaining and safeguarding all company funds and/or assets which they have in their possession or control. Additionally, all employees are responsible for submission of accurate reporting documents pertaining to payroll (timesheets, etc.) and reimbursement requests (expense reports, tuition reimbursement, etc.).

Drug-free Workplace

Pace Analytical recognizes that alcoholism and other drug dependencies are a significant social problem with a potential for causing severe detriment to the workforce. Employees have the right to work in an alcohol and drug-free environment. Employees are not to report to work under the influence of alcohol or controlled substances as prescribed in the Drug-free Workplace Program. The possession, use and sale of alcohol and controlled substances as well as detailed information regarding drug testing is described in the Drug-Free Workplace Program Policy handout provided to all new employees. Additional copies are available from Human Resources. Employees are obligated to conform to the strict Drug-Free Workplace Program Policy.

Conflict of Interest

Pace Analytical employees must avoid situations that might involve a conflict of interest or appear questionable to others. The employee must be careful in two general areas:

* Participation in activities that conflict or appear to conflict with Pace Analytical responsibilities.

* Giving or receiving anything that might influence the recipient or cause another person to believe that the recipient may be influenced. This includes offering or accepting bribes, kickbacks or illegal payments.

Employees are not to engage in outside business or economic activity relating to a sale or purchase by the Company. Other questionable activities include service on the Board of Directors of a competing or supplier company, significant ownership in a competing or supplier company, employment for a competing or supplier company or participation in any outside business during the employee's work hours.

The acceptance of gifts, cash, loans or other consideration in excess of $50 in value is not permitted for employees or their families when such gifts come from any individual, firm or corporation doing or seeking to do business with Pace Analytical.

Non-Harassment

Pace Analytical endeavors to provide a workplace free of both harassment and discrimination. Harassment of an employee or job applicant on the basis of race, color, creed, religion, national origin, sex, disability, age, marital status, sexual orientation, or any characteristic protected by applicable municipal, state, and federal laws is both illegal and a violation of company policy. Pace Analytical maintains a Sexual Harassment Policy that clearly defines the company's stance against sexual harassment and provides a mechanism for reporting infractions. The Sexual Harassment Policy is addressed in employee orientation, and employees are provided the Policy handbook. Additional copies are available from Human Resources.

Proper and Professional Work Environment

Employees are bound to use fairness, honesty and regard for the law in their business relationships with Pace Analytical investors, clients, suppliers, employees, and applicants as well as all local, national and international communities and governments.

Protection of Property

Pace Analytical employees have an obligation to protect all company and client property against loss, theft and misuse. Employees are responsible for maintaining an orderly, clean workplace. Employees are also liable for using company and client property for intended purposes only. Employees are prohibited from using company property for their personal use without the expressed permission of their supervisor or General Manager. No such use of property may be made after termination of employment with Pace Analytical. Employees must also make every effort to prevent the misuse of company and client property by other persons. Misuse includes selling, loaning or giving away company or client property.

Communications

Each employee is responsible for obtaining the information necessary to follow directives in this Ethics and Conduct document, and for reporting to their management or Human Resources representative any observed deviations from policies. The identity of the employee reporting the infraction will not be disclosed without his/her permission unless disclosure is unavoidable during an investigation. No adverse action will be taken against a Pace Analytical employee because he/she has reported a suspected impropriety. These reports will be treated in confidence to the maximum extent consistent with the fair and rigorous enforcement of the Code of Ethics and Standards of Conduct.

Compliance

All employees are required to read, understand and comply with the various components of the standards listed in this document. As confirmation that they understand this responsibility, each employee is required to sign an acknowledgment form that becomes part of the employee's permanent record (an example follows).

ACKNOWLEDGMENT

As an employee of Pace Analytical, I understand that the Company endeavors to abide by the highest professional, ethical standards and demands as much of its employees.

Those standards, as outlined in this document, have been made known to me and I understand my responsibility to follow them as they pertain to the functions of my job. I understand that failure to comply with the terms set forth within this document will result in disciplinary action up to and including termination.

I specifically acknowledge the responsibility for compliance with the contents of this manual that apply to my duties. When performing analytical testing functions I am responsible for compliance with the entire contents of this document.

Name: ____

Signature: ____

Date: ____

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3.0 ORGANIZATION AND PERSONNEL

Each laboratory within the system is set up as an individual entity with local management, but all share common systems and receive support from the Corporate Office. The Corporate Office centralizes company wide accounting, business development, financial management, human resources development, information systems, marketing and quality activities. Pace Analytical's Director of Quality, Safety and Training is responsible for assisting the development, implementation and monitoring of quality programs for the company. See Figure 3.1 for the Corporate Organizational structure.

3.1 LABORATORY ORGANIZATION AND DESCRIPTION OF RESPONSIBILITIES

Each laboratory is managed by a General Manager. Quality Assurance individuals at each lab report directly to the General Manager but receive guidance and direction from the Corporate Director of Quality, Safety and Training.

Under the direction of the General Manager, the technical staff of the laboratory is generally organized into the following functional groups:

Organic/Inorganic Sample Preparation
Wet Chemistry Analysis
Metals Analysis
GC and GC/MS Volatiles Analysis
GC and GC/MS Semi-volatiles Analysis

Figure 3.2 represents a typical organizational structure for a laboratory operation. The organizational structure for a specific laboratory is part of each laboratory's addendum to this Quality Manual.

3.2 REGIONAL LABORATORY JOB DESCRIPTIONS

3.2.1 General Manager or Laboratory Manager

1. Oversees laboratory operations.
2. Authorizes personnel development including staffing, recruiting, workload scheduling, employee retention and motivation.
3. Prepares budgets and staffing plans.
4. Oversees Project Manager's activities.
5. Monitors the Quality Systems of the laboratory and advises Quality Assurance Officer accordingly.

3.2.2 Project Manager

1. Coordinates all aspects of specific projects.
2. Focal point for client contact pertaining to project requirements (including methodology, turn-around time, technical information) and project status.
3. Arranges bottle orders and shipment of sample kits to clients.

4. Verifies log-in information relative to project requirements and field sample Chains-of-Custody.
5. Communicates with operations staff to update and set project priorities.
6. Provides results to clients in the requested format (verbal, hardcopy, electronic, etc.).
7. Works with clients, laboratory staff, and other appropriate Pace Analytical staff to develop project statements of work or resolve problems of data quality.

3.2.3. Quality Assurance Officer (QAO)

1. Oversees the laboratory Quality Systems
2. Executes Quality Control procedures to ensure that the laboratory achieves established standards of quality.
3. Maintains records of quality control data and evaluates data quality.
4. Monitors laboratory activities to determine conformance with authorized QA policy, and to implement appropriate steps to ensure adherence to QA programs.
5. Conducts periodic internal audits and coordinates external audits performed by regulatory agencies or client representatives.
6. Reviews and maintains records of proficiency testing results.
7. Maintains a current distribution list for copies of quality documents.
8. Assists in development and implementation of appropriate training programs.
9. Provides technical support to laboratory operations regarding methodology and project QA/QC requirements.
10. Maintains certifications from federal and state programs.

3.2.4 Operations Manager or Department Manager/Supervisor

1. Oversees the day-to-day production and quality activities of the laboratory.
2. Ensures that quality assurance and quality control criteria of analytical methods and projects are satisfied.
3. Assesses data quality and takes corrective action when necessary.
4. Approves and releases technical and data management reports.

3.2.5 Group Supervisor/Leader

1. Trains analysts in laboratory operations and analytical procedures.
2. Organizes and schedules analyses with consideration for sample holding times.
3. Implements data verification procedures by assigning data verification duties to analysts.
4. Evaluates instrument performance and supervises instrument calibration and preventive maintenance programs.
5. Reports non-compliance situations to laboratory management including the Quality Assurance Officer.

3.2.6 Analysts

1. Analyzes samples according to published methods and laboratory procedures.
2. Monitors quality control data. This includes examination of raw data such as chromatograms as well as an inspection of reduced data, calibration curves, and laboratory notebooks.

3.2.7 Sample Management Personnel

1. Signs for incoming samples and verifies the data entered on the Chain-of-Custody forms.
2. Enters the sample information into the Laboratory Information Management System (LIMS) for tracking and reporting.
3. Stores samples according to EPA requirements.
4. Assists Project Managers in filling bottle orders and sample shipments.

3.3 TRAINING AND ORIENTATION

Each new employee receives a five part orientation: human resources, ethics, safety, quality assurance, and supervisory. The human resources orientation involves matters of immediate personal concern such as benefits, salary, and company policies. The ethics orientation focuses on core values and workplace integrity. The safety orientation is an in-depth examination of the Pace Analytical Chemical Hygiene Plan and safety program, which are consistent with the requirements of OSHA's Hazard Communication Program (29 CFR 1910.1200). The Quality Assurance orientation provides the new employee with information on the laboratory's Quality Systems through an introduction to the Quality Manual and SOPs, acceptable record keeping practices, and the individual's responsibility with respect to the Quality System. The new employee's Supervisor provides the employee with a basic understanding of the role of the laboratory within the structure of Pace Analytical and the basic elements of that individual's position.

Supervised training uses the following techniques:

- Hands-on training
- Lectures and training sessions
- Method-specific training packages on PaceNet (WAN)
- Conferences and seminars
- Short courses
- Specialized training by instrument manufacturers
- Proficiency sample programs.

Group Supervisors/Leaders are responsible for providing documentation of training and proficiency for each employee under their supervision. The employee's training file indicates what procedures an analyst or a technician is capable of performing, either independently or with supervision. The files also include documentation of continuing competence. Training documentation files for each person are kept in a central location in each laboratory. The Quality Assurance Officer is responsible for maintaining the training files. These files include a current resume or curriculum vitae.

3.4 LABORATORY SAFETY

It is the policy of Pace Analytical to make safety and health an integral part of daily operations and to ensure that all employees are provided with safe working conditions, protective equipment, and requisite training to do their work without injury. Each employee is responsible for his/her own safety by complying with established Company rules and procedures.

Sample receiving areas and laboratories are equipped with suitable hoods, protective clothing and eye wear, gloves, barrier creams and any other appropriate measures to prevent or minimize staff contact with hazardous substances. Appropriate safety equipment such as eyewash stations, drench showers, spill absorbents and neutralizers, fire extinguishers, and first aid materials are available.

Each laboratory has a designated Safety Officer. This officer prepares and maintains the laboratory's Chemical Hygiene Plan/Safety Manual, conducts safety and occupational health orientation, safety training and review sessions as required, and maintains up-to-date familiarity with safety and occupational health issues pertinent to the laboratory.

3.5 SECURITY AND CONFIDENTIALITY

Three tiers of security are maintained within Pace Analytical for the purpose of controlling external influences on samples, analytical processes, and data.

The first tier of security maintained is controlled access to laboratory buildings. Exterior doors to laboratory buildings remain either locked or continuously monitored by Pace Analytical staff. Keyless door-lock combinations (and computer access codes/logins) are changed on a regular basis. Posted signs direct visitors to the reception office and mark all other areas as off limits to unauthorized personnel. All visitors to the facilities must sign the Visitor's Logbook maintained by the receptionist. All visitors are accompanied by a staff member during the duration of their stay on the premises. The staff member escorts the visitor back to the reception area at the end of his/her visit where he/she signs out the Visitor's Logbook. Prior to departure of the last staff member at the close of each day the facility is checked for security.

The second security level is within the facility and designated by the General Manager. Individual Operations Manager or Group Supervisors close specific areas under their responsibility to entry by unauthorized persons. "Closed Areas" are designated by prominent postings at all points of access.

The final tier of security is comprised of specific secure areas for sample, data and client report storage. These areas are lockable within the facilities, or are in secure offsite storage. Access is limited to specific individuals or their designees. Security of sample storage areas is the responsibility of the Sample Custodian. Security of samples and data during analysis and data reduction is the responsibility of Group Supervisors. Security of client report archives is the responsibility of the Quality Assurance Officer or Client Services Manager. These secure areas are locked whenever these individuals or their designees are not present in the facility.

Access to designated laboratory sample storage locations is limited to authorized personnel only. Provisions for lock and key access are provided. No samples are to be removed without proper authorization. If requested by client or contract, samples are not to be removed from secure storage areas without filling out the associated Chain-of-Custody records.

Standard business practices of confidentiality are applied to all documents and information regarding client analyses. Specific protocols for handling confidential documents are described in Pace Analytical SOPs. Additional protocols for internal identification of samples and data by number only are implemented as required under contract-specific Quality Assurance Project Plans (QAPPs).

Figure 3.1

Corporate/Management Structure

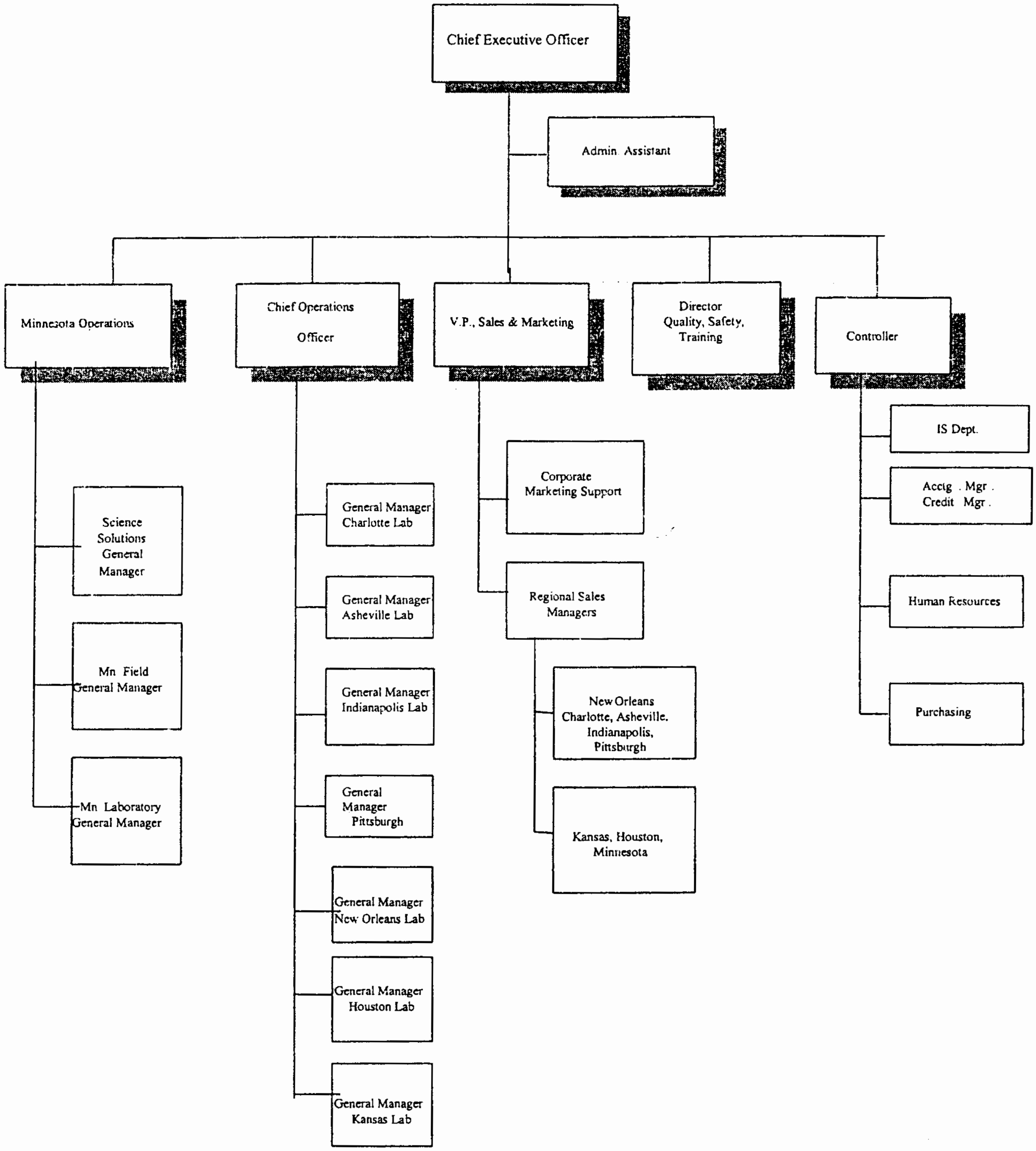
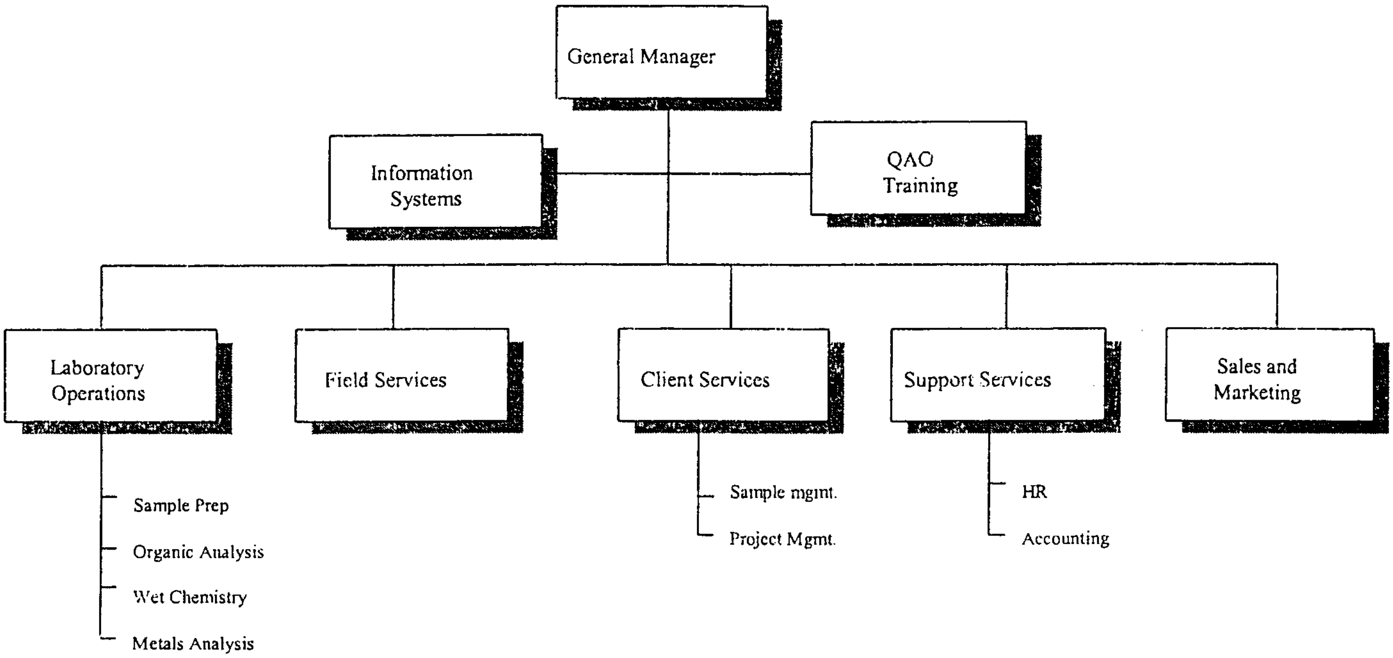


Figure 3.2

Typical Laboratory Organizational Chart



4.0 QUALITY SYSTEM

The quality assurance objective of Pace Analytical is to provide data of known and documented quality. To accomplish this objective, Pace Analytical laboratories have established a Quality System incorporating the following items.

4.1 QUALITY DOCUMENTATION

4.1.1 Quality Manual

The Quality Manual describes management policies related to laboratory and associated operations. It defines acceptable practices and discusses each element of the Quality System. It functions as the Project QA Manual where no other project-specific plan exists. Adherence to the practices described in this manual is required of all employees. Each regional laboratory may add an addendum to this Quality Manual to address laboratory-specific information.

4.1.2 Project QA Manual

Project QA Manuals are implemented as required. These include such documents as Quality Assurance Project Plans (QAPPs). For those projects which require specific QA/QC criteria, it is intended that Pace Analytical be directly involved in the development of the appropriate sections prior to any approval process. In some cases, the analytical section of a QAPP is written by Pace Analytical for the client. In this instance, the QAPP is reviewed and approved by the appropriate Pace Analytical Quality Assurance Officer and Operations Manager.

4.1.3 Method Standard Operating Procedures (SOPs)

SOP's are written procedures related to sample collection, storage, preparation, analysis, disposal, data validation, data reporting and employee training and safety. Each SOP contains the elements outlined in the Pace Analytical Corporate ALL-P-001, "Guidance Document for Pace Analytical for the Preparation of Standard Operating Procedure Documents". SOP's are assigned a number from the Inventory List for SOPs maintained by the Corporate Quality Office or the Quality Assurance Department of the individual lab, as applicable.

All SOPs will be reviewed every two years at a minimum. Independent of the minimum review frquency, revisions will be incorporated as needed if procedures or methods change. Retired SOPs are maintained by the Quality Office with the date of retirement to demonstrate procedures for any given time period. Review dates and applicable signatures for SOPs not requiring changes are maintained with the original document.

4.1.4 Minimum Requirements Documents (MRDs)

MRD's are static documents that outline the minimum requirements of analytical methods to ensure that the work completed by an analyst is method-compliant.

These documents are consistent throughout the Pace laboratory network, and are maintained and distributed by local operations QAOs.

4.1.5 Work Processing Documents (WPDs)

The Work Processing Documents detail how the work flows through the lab for a particular analytical method. These documents follow the flow of samples from receipt to preparation to analysis to data validation to reporting. These documents are consistent throughout the Pace laboratory network. These documents are also maintained and distributed by the local operations QAOs.

4.1.6 Training Documents (TDs)

The training documents are more detailed versions of the work processing documents. The training documents describe each analytical procedure in detail including computer and equipment set-up, sample preparation and analysis, data validation steps, and data packet preparation. Documentation that an analyst has completed their training via these training documents is maintained in their training file. These training documents are consistent throughout the company. Specific details related to instrument vendor may be revised at the local level.

4.2 QA/QC MONITORING DEVICES

4.2.1 Method Detection Studies

Pace Analytical Services performs and documents detection limit studies for each instrument. If an instrument is utilized for more than one method, a detection limit is performed for each method on that instrument. The protocol utilized for the detection limit determination for analyses performed on samples analyzed for the Safe Drinking Water Act (SDWA) and the Clean Water Act (CWA) is based on the protocol defined in 40 CFR 136, Appendix B. The matrix for the CWA and the SDWA samples is analyte-free spiked deionized water. Detection limits for Resource Conservation Recovery Act (RCRA) samples are determined based on the protocol defined in SW 846, Third Edition, Chapter One, Volume 1A. The detection limit protocol for CWA and SDWA samples is also acceptable for RCRA program samples.

A method detection limit (MDL) check sample, spiked at or just above the MDL, is run annually. Detection limits are updated based on one or more of the following criteria: when there is a change in test method that affects how the test is performed; or when a change in instrumentation occurs that affects the sensitivity of the analysis. The relationship of the detection limits to the reporting limits ensures that the reporting limit is always supported by a current detection limit.

IT IS IMPERATIVE TO NOTE THAT METHOD DETECTION LIMITS ARE HIGHLY MATRIX DEPENDENT. LIMITS DETERMINED BY PACE ANALYTICAL MAY NOT BE ACHIEVABLE IN ALL MATRICES.

4.2.2 Initial Demonstrations of Capability

See Table 7.2, Reference 14, Chapter 5, Section 5.10.2.1.

4.2.3 Proficiency Testing Studies

See Section 10.3 for a full description of this device.

4.2.4 Control Charts

See Section 9.4 for a full description of this device.

4.3 DOCUMENT CONTROL SYSTEM

All SOPs and subsequently referenced documents (published methods, bench instructions, equipment manuals, original forms) are maintained by the Quality Office as controlled documents. Required information for each document includes:

- The range of effective dates
- The number and location of controlled copies
- A revision number or designation which can be used to demonstrate continuity

Any revision of a controlled document necessitates:

- Retirement and maintenance of the previous version
- Replacement of all controlled copies and destruction of retired version copies
- Notification of all affected personnel that a revision has been issues

As an alternative to the hard copy system of control, secured electronic copies of controlled documents may be maintained on the local or wide-area network (WAN). These document files must be read-only for all personnel except the Quality Department and system administrator. Other requirements for this system include:

- Ready accessibility to all laboratory staff
- A complete description of the computerized aspects, including security
- A provision to explicitly indicate that all printed copies are uncontrolled and expire on the date which they were printed.

Controlled copies of SOPs are issued to, and maintained in each applicable section. A complete set of SOPs is maintained in the Quality Assurance Office and is made available to all facility personnel.

5.0 SAMPLE CUSTODY

5.1 SAMPLING SUPPORT

Pace Analytical provides shipping containers, custody documents, chemical preservatives and field quality control to support field sampling events. Tables 5.1, 5.2 and 5.3 list general guidelines for sample container types, preservatives and holding times for a variety of methods. Note that all analyses listed are not necessarily performed at all Pace Analytical locations and there may be additional laboratory analyses performed that are not included in these tables. Pace Analytical can provide pick up and delivery services to their clients.

5.2 SAMPLE RECEIPT AND ACCEPTANCE

Sample shipments are received at the sample receiving area. Sample management personnel verify the number of shipping containers received against the shipping manifest/Chain-of-Custody. Any damage to the shipping containers or other discrepancies observed are noted on the Chain-of-Custody. A copy is filed for future reference.

The external Chain-of-Custody is signed by the carrier for relinquishment of samples and signed by sample management personnel for sample receipt. The actual Chain-of-Custody may be supplied by Pace Analytical (Figure 5.1), or may be the client's own form. The Chain-of-Custody remains in the project file with the assigned project manager at all times.

5.3 CHAIN OF CUSTODY

The Chain-of-Custody encompasses three major elements: field sampling, laboratory analysis and final data file. A Chain-of-Custody (COC) document may be the means in some types of legal proceedings by which evidence of custody of samples from time of receipt to completion of analysis is proven in the courts. It is important that these documents be as complete as possible. Pace Analytical has implemented standard operating procedures to ensure that sample custody objectives of traceability and responsibility are achieved for every project.

Field personnel or client representatives complete a Chain-of-Custody form for all samples. Samples are received by the laboratory accompanied by these forms.

The sampler is responsible for providing the following information:

- Client project name
- Project location
- Field sample number/identification
- Date and time sampled
- Sample type
- Preservative
- Requested analyses
- Sampler signature
- Relinquishing signature

- Date and time relinquished
- Sampler remarks
- Custody Seal Number (if applicable)

The record is filled out completely and legibly. Errors are corrected by drawing a single line through and initialing and dating the error. All transfers of samples must be recorded on the Chain-of-Custody in the "relinquished" and "received by" sections. All information except signatures should be printed.

5.4 SAMPLE VERIFICATION

Sample management personnel perform an inspection of each sample shipment upon arrival. The following items are checked:

1. Presence/absence of custody seals or tapes of the shipping containers and the condition of the seals (i.e., intact, broken).

2. Presence/absence of Chain-of-Custody and its completeness (Section 5.3)

3. Presence/absence of sample tags (if present, are they removable?).

4. Agreement/non-agreement between the sample tags, Chain-of-Custody, and any client documentation.

5. Condition of the samples when received, including:

   - Sample temperature
   - Intact, broken/leaking
   - Headspace in VOA vials
   - Sample holding time
   - Sample pH when required
   - Adequate sample volume provided
   - Appropriate containers/preservatives used

If discrepancies are found, the Pace Analytical project manager is contacted immediately. If the project manager is not available, the QAO is contacted for further directions. Discrepancies are documented and reported with analytical results.

5.5 SAMPLE LOG-IN

5.5.1 General Policies

1. After the sample verification inspection, all sample information on the Chain-of-Custody must be entered into the Laboratory Information Data Management System (EPIC).

   Sample data must include:

   - Client name and contact

- Client number
- Pace Analytical project number
- Pace Analytical project manager
- Sample descriptions
- Due date
- List of analyses requested

2. All samples received are logged into EPIC within one working day of receipt. Sample log in may be delayed due to client clarification of analysis needed, corrective actions for sample receipt non-conformance, or other unusual circumstances.

3. All samples are assigned a unique Identification code that is unequivocally linked to the field Identification code.

4. Sample labels are printed from EPIC and affixed to each sample container.

5.6 WHEN SAMPLES ARE RECEIVED WITH NO DOCUMENTATION

5.6.1. If delivered by a client, the client completes a chain of custody and/or request for analysis, relinquishes samples to sample management personnel, and is given a copy of the COC.

5.6.2. If received by courier or shipping, the Client Services manager or Project Manager is consulted to contact the client to obtain sample and project information.

5.6.3. If analysis information cannot be determined on the day of sample receipt, sample data entry personnel proceed to assign sample numbers and put samples on hold. Follow-up with project manager occurs until the analyses are determined and samples can be properly logged in.

5.7 SAMPLE STORAGE/STAGING

5.7.1. Refrigerated Area Maintenance

All refrigerated areas are maintained at 4°C (+/- 2°C). The temperature is monitored and recorded each work day. If the temperature fails outside the limits of 2° - 6°C, corrective action is taken as follows and appropriately documented (see Section 12).

1. Temperature is rechecked after an hour to verify temperature exceedance. Initiate corrective action if necessary.

2. QAO and laboratory management are notified if the problem persists.

3. Relocate samples to a proper environment if temperature cannot be maintained after corrective actions are implemented.

4. Affected clients are notified.

5.7.2. Hazardous Materials

Pure product or potentially heavily contaminated samples are tagged as "hazardous" or "lab pack" and stored separate from other samples.

5.7.3 Foreign Soils

Depending on the soil disposal practices of the laboratory, foreign soils are segregated since the USDA requires these samples to be incinerated or autoclaved prior to disposal.

5.8 SAMPLE ACCESS AND TRACKING

5.8.1. General Policies and Procedures

Pace laboratory facilities are operated under controlled access to ensure sample and data integrity. Only employees are allowed into the laboratory facilities. Visitors must register at the front desk and be properly escorted.

Samples are removed from their proper location by designated personnel and returned to a storage area, if necessary, immediately after the required sample quantity has been taken.

Upon client request, additional and more rigorous Chain-of-Custody protocols for samples and data can be implemented. For example, projects for which the "secure area" designation is not sufficient, analysts and technicians follow strict internal Chain-of-Custody procedures to further ensure the security of samples. All samples are signed out when they are removed for analysis. Samples are signed back in noting date, time, and storage location upon return.

5.9 SUBCONTRACTING ANALYTICAL SERVICES

Every effort is made to perform chemical analyses for Pace Analytical clients within a company laboratory. When subcontracting to an external laboratory becomes necessary, a preliminary verbal communication with an appropriate laboratory is undertaken. Work performed under specific protocols may involve special consideration. The contact and preliminary arrangements and terms of agreement are made between the Pace Analytical Project Manager and the appropriate subcontract laboratory personnel (i.e., Laboratory Manager, customer services contact, or the appropriate laboratory section manager). The specific terms of the subcontract laboratory agreement includes the requirement for provision of the following (when applicable):

- Method (EPA or otherwise) of analysis
- Number and type of samples expected
- Project specific QA/QC requirements
- Deliverables required
- Laboratory certification requirement
- Price per analysis
- Turn around time requirements

Chain-of-Custody forms are generated for samples which require subcontracting to other laboratories. The sample management personnel repackage the samples for shipment, create a transfer Chain-of-Custody form and record the following information:

- Pace Analytical Laboratory Number
- Matrix
- Requested analysis
- Special instructions (quick turn-around, required detection or reporting limits, unusual information known about the samples or analytical procedure).
- Signature in "Relinquished By"

All subcontracted sample data reports are sent to the Pace Analytical Project Manager. Any Pace Analytical work sent to other labs within the Pace Analytical network is handled as subcontracted work.

5.10 SAMPLE DISPOSAL

After completion of sample analysis and submission of the analytical report, unused portions of samples are retained by the laboratory for a minimum of 30 days unless otherwise stated by the project contract or client request. After this period expires, non-hazardous samples will be disposed of according to the nature of the samples.

<u>For In-House Sample Disposal</u>

All preserved water, non-hazardous: Neutralize/Sewer

Unpreserved water, non-hazardous: Sewer

Soil/Sludge, non-hazardous: Refuse Disposal

All VOA's, non-hazardous: Neutralize/Sewer

Samples Extracts/Digestates, non-hazardous: Neutralize/Sewer

The preferred method for disposition of hazardous samples is to return the excess sample to the client. It may not be feasible to return samples, or the client may require Pace Analytical to dispose of excess samples. Pace Analytical will charge a disposal fee to recover costs of this service.

Figure 5.1
Pace Analytical Services, Inc. CHAIN-OF-CUSTODY FORM (EXAMPLE)

Pace Analytical

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

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Section A Required Client Information:

Company	
Address	
Phone	Fax

Section B Required Client Information:

Report To:
Invoice To:
P.O.
Project Name:
Project Number:

Client Information (Check quote/contract):

Requested Due Date:	*TAT:

* Turn around times less than 14 days subject to laboratory and contractual obligations and may result in a Rush Turnaround Surcharge.

Turn Around Time (TAT) in calendar days.

Section C To Be Completed by Pace Analytical and Client

Quote Reference:
Project Manager:
Project #:
Profile #:
Requested Analysis:

Section D Required Client Information:

SAMPLE ID

One character per box.
(A-Z, 0-9 / ,-)
Sample IDs MUST BE UNIQUE

Valid Matrix Codes

MATRIX	CODE
WATER	WT
SOIL	SL
OIL	OL
WIPE	WP
AIR	AR
TISSUE	TS
OTHER	OT

ITEM #	SAMPLE ID	MATRIX CODE	DATE COLLECTED mm / dd / yy	TIME COLLECTED hh:mm a/p	# Containers	Preservatives: Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Requested Analysis	Remarks / Lab ID
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													

Sample Condition		Sample Notes	Item No.	Relinquished By / Company	Date	Time	Accepted By / Company	Date	Time
Temp in °C:									
Received on ICE:	Y / N								
Sealed Cooler:	Y / N								
Samples Intact:	Y / N								

Additional Comments:

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER:	
SIGNATURE of SAMPLER:	DATE Signed: (MM / DD / YY)

SEE REVERSE SIDE FOR INSTRUCTIONS

TABLE 5.1 List of Containers, Preservatives and Holding Times for Inorganic and Organic Analyses of Aqueous Samples:

NAME	CONTAINER[1]	PRESERVATION[2]	MAXIMUM HOLDING TIME[3]
Inorganic Tests:			
Acidity	P,G	Cool, 4^{0}C	14 days
Alkalinity	P,G	Cool, 4^{0}C	14 days
Ammonia	P,G	Cool, 4^{0}C, H_2SO_4 to pH<2	28 days
Biochemical oxygen demand	P,G	Cool, 4^{0}C	48 hours
Bromide	P,G	None Required	28 days
Biochemical oxygen demand, carbonaceous	P,G	Cool, 4^{0}C	48 hours
Chemical oxygen demand	P,G	Cool, 4^{0}C, H_2SO_4 to pH<2	28 days
Chloride	P,G	None Required	28 days
Chlorine, total residual	P,G	None Required	Analyze immediately
Color	P,G	Cool, 4^{0}C	48 hours
Cyanide, total amenable to chlorination	P,G	Cool, 4^{0}C, NaOH to pH>12 0.6g ascorbic acid[4]	14 days
Fluoride	P	None Required	28 days
Hardness	P,G	HNO_3, to pH<2, H_2SO_4 to pH<2	6 months
Hydrogen ion (pH)	P,G	None Required	Analyze immediately
Kjeldahl and organic nitrogen	P,G	Cool, 4^{0}C, H_2SO_4 to pH<2	28 days
Metals:			
Chromium VI	P,G	Cool, 4^{0}C	24 hours
Mercury (SW846)	P,G	HNO_3 to pH<2	28 days in glass
Mercury (CLP, 200 series)	P,G	HNO_3 to pH<2	28 days
Metals, except chromiumVI and mercury	P,G	HNO_3 to pH<2	6 months
Nitrate	P,G	Cool, 4^{0}C	48 hours
Nitrate-nitrite	P,G	Cool, 4^{0}C, H_2SO_4 to pH<2	28 days
Nitrite	P,G	Cool, 4^{0}C	48 hours
Oil and grease	G	Cool, 4^{0}C, H_2SO_4 to pH<2	28 days
Organic carbon	P,G	Cool, 4^{0}C, H_2SO_4 to pH<2	28 days
Orthophosphate	P,G	Filter immediately, Cool, 4^{0}C	48 hours
Phenols	G only	Cool, 4^{0}C, H_2SO_4 to pH<2	28 days
Phosphorus (elemental)	G	Cool, 4^{0}C	48 hours
Phosphorus, total	P,G	Cool, 4^{0}C, H_2SO_4 to pH<2	28 days
Residue, total	P,G	Cool, 4^{0}C	7 days
Residue, filterable	P, G	Cool, 4^{0}C	7 days
Residue, nonfilterable (TSS)	P, G	Cool, 4^{0}C	7 days
Residue, Settleable	P, G	Cool, 4^{0}C	48 hours
Residue, volatile	P, G	Cool, 4^{0}C	7 days
Silica	P	Cool, 4^{0}C	28 days

TABLE 5.1 (cont.) List of Containers, Preservatives and Holding Times for Inorganic and Organic Analyses of Aqueous Samples:

NAME	CONTAINER[1]	PRESERVATION[2]	MAXIMUM HOLDING TIME[3]
Inorganics Continued:			
Specific conductance	P,G	Cool, 4^0C	28 days
Sulfate	P,G	Cool, 4^0C	28 days
Sulfide	P,G	Cool, 4^0C, add zinc acetate & sodium hydroxide to pH>9	7 days
Sulfite	P,G	None Required	Analyze immediately
Surfactants	P,G	Cool, 4^0C	48 hours
Turbidity	P,G	Cool, 4^0C	48 hours
Organic Tests:			
Oil and Grease	G	Cool, 4^0C, HCl or H_2SO_4 to pH<2	28 days
Organic carbon, Total (TOC)	P,G	Cool, 4^0C, HCl or H_2SO_4 to pH<2	28 days
Purgeable Halocarbons	G,Teflon-lined septum	Cool, 4^0C, 0.008% $Na_2S_20_3$[4], HCl[5,6] to pH<2	14 days
Purgeable Aromatic Hydrocarbons	G,Teflon-lined septum	Cool, 4^0C, 0.008% $Na_2S_20_3$[4], HCl[5,6] to pH<2	14 days
Acrolein and acrylonitrile	G,Teflon-lined septum	Cool, 4^0C, 0.008% $Na_2S_20_3$[4] Adjust pH to 4-5	14 days
Phenols	G,Teflon-lined cap	Cool, 4^0C, 0.008% $Na_2S_20_3$[4]	7 days until extraction, 40 days after extraction
Benzidines	G,Teflon-lined cap	Cool, 4^0C, 0.008% $Na_2S_20_3$[4]	7 days until extraction, 40 days after extraction
ıalate esters	G,Teflon-lined cap	Cool, 4^0	7 days until extraction, 40 days after extraction
Nitrosamines	G,Teflon-lined cap	Cool, 4^0C, store in dark, 0.008% $Na_2S_20_3$[4]	7 days until extraction, 40 days after extraction
PCBs	G,Teflon-lined cap	Cool, 4^0C	7 days until extraction, 40 days after extraction
Nitroaromatics and cyclic ketones	G,Teflon-lined cap	Cool, 4^0C, store in dark, 0.008% $Na_2S_20_3$[4]	7 days until extraction, 40 days after extraction
Polynuclear aromatic hydrocarbons	G,Teflon-lined cap	Cool, 4^0C, 0.008% $Na_2S_20_3$[4]	7 days until extraction, 40 days after extraction
Haloethers	G,Teflon-lined cap	Cool, 4^0C, 0.008% $Na_2S_20_3$[4]	7 days until extraction, 40 days after extraction
Chlorinated Hydrocarbons	G,Teflon-lined cap	Cool, 4^0C, HCl or H_2SO_4	7 days until extraction, 40 days after extraction
Dioxins and Furans	G,Teflon-lined cap	Cool, 4^0C, 0.008% $Na_2S_20_3$[4]	40 days until extraction, 40 days after extraction
Total organic halides (TOX)	G,Teflon-lined cap	Cool, 4^0C, HCl or H_2S0_4 to pH <2	28 days
Pesticides	G,Teflon-lined cap	Cool, 4^0C pH 5-9	7 days until extraction, 40 days after extraction

Table Footnotes:
1 Polyethylene (P) or glass (G)
2 Sample preservation should be performed immediately upon sample collection.
3 Holding times are based from time of sample collection.
4 Should only be used in the presence of residual chlorine.
5 Free chlorine must be removed prior to addition of HCl by the appropriate addition of $NA_2S_2O_3$
6 Sample receiving no pH adjustment must be analyzed within seven days of sampling.

Table 5.2 Required Containers, Preservation Techniques, and Holding Times for Non-Aqueous, Soil or Solid Matrices (as specified in SW-846):

NAME	CONTAINER	PRESERVATION	MAXIMUM HOLDING TIME[1]
Semivolatile Organics/Organochlorine Pesticides/PCBs and Herbicides			
Concentrated waste samples	8 oz. wide mouth glass w/Teflon liner	None	14 days until extraction, 40 days after extraction
Liquid samples, no residual Chlorine present	1 gal. or 2 1/2 gal. amber glass w/Teflon liner	Cool, 4°C	Samples must be extracted within 7 days & extracts analyzed within 40 days
Residual Chloride, present	1 gal. or 2 1/2 gal. amber glass w/Teflon liner	Add 3mL 10% sodium thiosulfate	Samples must be extracted within 7 days & extracts analyzed within 40 days
Soil/sediments and sludges	8 oz. wide mouth glass w/Teflonliner	Cool, 4°C	14 days until extraction, extracts analyzed within 40 days.
Volatile Organics			
Concentrated waste samples	8 oz. wide mouth glass w/Teflonliner	None	14 days
Liquid samples, no residual Chlorine present	3x40 mL vials w/Teflon lined septum caps	Cool, 4°C[2]	14 days
Residual Chlorine, present	3x40 mL vials w/Teflon lined septum caps	Collect sample in a 4 oz. soil VOA container which has been pre-preserved w/4 drops of 10% sodium thiosulfate. Gently mix sample & transfer to a 40mL VOA vial[2]. Cool to 4°C	14 days
Acrolein & Acrylonitrile	3x40 mL vials w/Teflon lined septum caps	Adjust to pH 4-5, Cool to 4°C	14 days
Soil/sediments and sludges	4 oz. (120mL), wide mouth glass w/Teflon liner or wide mouth glass container sealed w/a septum	Cool to 4°C	14 days

[1] Holding times are based from time of sample collection.
[2] Adjust pH<2 w/H_2SO_4, HCl or solid $NaHSO_4$

Table 5.3 Required Containers, Preservation, and Technical Hold Times for Air Methods:

TEST	MEDIA	PRESERVATION	MAXIMUM HOLDING TIME [1.]
TO1	Tenax tubes	Freezer - 20°C	14 days
TO2	Carbo Sieve	Cool to 4°C	14 days
VOST	Tenaz/Tenaz-charcoal	Cool to 4°C	14 days
TO4	Puf 3" long, 60mm diameter	Freezer - 10°C or below	Extracted 7 days after collection
TO1O	Puf 10cm long, 20mm diameter	Cool to 4°C	Extracted 7 days after collection
TO11	Absorbent cartridge	Cool to 4°C	30 days
TO13	Puf XAD/XAD		Extracted 7 days after collection
TO14	Summa canisters Tedlar bags	Room temperature Room temperature	Not specified 48-72 hours (dependant on client)
T09	PUF XAD/XAD	Cool to 4°C	30 days
Method 3C	Summa cannisters Tedlar bags	Room temperature	15 days
Method 23	XAD	Cool to 4°C	30 days

1. Holding times are based from time of sample collection.

6.0 CALIBRATION PROCEDURES AND FREQUENCY

Equipment/instrumentation is calibrated before each use to ensure proper functioning. All calibrations are performed by an experienced analyst at scheduled intervals against either certified standards which are traceable to recognized national standards, or reference standards whose values have been statistically validated. Equipment/instrumentation, or a component thereof which gives suspect results, cannot be calibrated to specifications, or is otherwise defective, is taken out of service and clearly labeled as "defective" or "out-of-service" until it has been repaired and tested to meet specifications. Equipment/instrumentation must perform its function within the stated specifications before being placed back into service. In the event that recalibration of a piece of test equipment casts doubt on the validity of test results already transmitted to the client, the client is notified promptly by the laboratory. Equipment/instrumentation found to be consistently out of calibration is either repaired and positively verified or replaced.

The discussion presented here is general in nature, because the requirements for calibration are instrument (or equipment) and method specific. Details of calibrations can be found in the Pace Analytical Standard Operating Procedures, analytical methods, and instrument operations manuals.

6.1 STANDARDS AND TRACEABILITY

The analytical standards used by Pace laboratories are purchased from certified vendors and are traceable to NIST certified materials as documented on certificates of analysis. These standards are used to prepare calibration and spiking solutions. Each laboratory department is responsible for the preparation, storage and disposal of its standards. The preparation information is recorded into department-specific Standards Notebooks in order to document traceability of prepared standards to their source material(s). The certificates of analysis are initialed and dated upon receipt and archived for future reference. Additional information concerning standards can be found in Section 9.3.

6.2 GENERAL CALIBRATION PROCEDURES

Calibration standards for each parameter are chosen to bracket the expected concentrations of those parameters in the sample <u>and</u> to operate within the linear response range of the instrument. Samples with analytical results that fall outside the calibration range are diluted and reanalyzed. A low level standard is routinely analyzed to verify the reporting limit. Calibration standards are prepared at a minimum of three concentration levels, usually chosen at two to five times, five to ten times, and up to twenty times the estimated method detection limit plus a calibration blank, with the exception of most organic analyses which do not require a calibration blank. Any specific method requirement for number and type of calibration standards supercedes the general requirement. Either an internal standard or external standard quantification technique can be utilized. The reporting limit is verified by analysis of a standard at the reporting limit.

Instrumental responses to calibration standards for each parameter are subjected to an appropriate statistical test of fitness (least squares linear regression, quadratic equation, or relative standard deviation of response factors) as required by the method or QAPP. The calibration must reflect an acceptable correlation of data points for linearity to be acceptable. In cases where the calibration data are outside these criteria, the analyst must rerun the calibration standards (meeting the same criteria) and/or prepare a new curve, changing instrumental conditions as necessary.

During the course of analysis, calibration standards are routinely analyzed to ensure that the instrumental response has not changed. The calibration verification criteria stipulated in each method or SOP are used by the analyst to determine whether the instrument is acceptable to analyze samples. Concentrations of continuous calibration verification standards (CCV or CCAL) are varied periodically to evaluate the entire calibration range.

The accuracy of prepared standards is periodically checked by comparison with a standard from an independent source.

Certain equipment such as balances, pH meters, and turbidity meters are calibrated with NIST traceable standard reference material.

6.2.1 Analytical Balances

Every 12 months, calibration of the entire analytical range is checked by a qualified service technician. The calibration of each balance is checked each day the balance is used with weights traceable to NIST. Calibration weights are ASTM Class 1 (replaces Class S designation) and are re-certified at a minimum of every two years. Some accrediting agencies may require checks more frequently. If balances are calibrated by an external agency, verification of their weights must be provided. All information pertaining to balance maintenance and calibration is recorded in the individual balance logbook and/or is maintained on file in the QA department.

6.2.2 Thermometers

Certified, or reference, thermometers are maintained for checking calibration of working thermometers. Reference thermometers are provided with NIST traceability for initial calibration and are re-certified, at a minimum, yearly with equipment directly traceable to NIST.

Working thermometers are compared with the reference thermometers every 12 months. Each thermometer is individually numbered. In addition, working thermometers are visually inspected by laboratory personnel prior to use.

Laboratory thermometer inventory and calibration data are maintained in the QA department.

6.2.3 pH/Electrometers

The meter is calibrated before use each day, and once after each four hours of continuous use using fresh buffer solutions.

6.2.4 Spectrophotometers

During use, spectrophotometer performance is checked at established frequencies in analysis sequences against initial calibration verification (ICV) with continuing calibration verification (CCV) standards.

Refer to specific MRDs for spectrophotometric methods.

6.3 GC/MS CALIBRATION PROCEDURES

The minimum operations necessary to satisfy analytical requirements associated with the determination of organic compounds in water and soil/sediment samples are listed below:

- Documentation of GC/MS mass calibration and abundance pattern
- Documentation of GC/MS response factor stability
- Internal standard response and retention time

Prior to initiating data collection, it is necessary to establish that a given GC/MS meets the standard mass spectral abundance criteria. This is accomplished through the analysis of decafluorotriphenylphosphine (DFTPP) for base/neutral and acid (BNA) compounds or p-bromofluorobenzene (BFB) for volatile compounds. Each GC/MS system used for analysis of volatile or semivolatile organic compounds is tuned to meet method or program-specific ion abundance criteria before analysis of standards, blanks, or samples can proceed.

Prior to the analysis of samples and after tuning criteria have been met, the GC/MS system is initially calibrated using multiple concentrations to determine the linearity of response. The number of concentration points used for calibration depends on the specific method criteria and/or client project requirements. USEPA criteria specify both the concentration levels for initial calibration and the specific internal standard to be used on a compound-by-compound basis for quantitation.

Refer to the MRDs for specific GC/MS procedures. Generally:

The response factor (RF) for each compound at each concentration level is calculated.

Using the average RF from the initial calibration, the percent relative standard deviations (%RSD) for compounds identified as Calibration Check Compounds (CCCs) are calculated.

RSD must be <30% for RFs of CCCs (if RSD of any compound is greater than 15%, use a least squares regression if correlation coefficient $\geq$0.995).

A calibration check standard containing all compounds of interest, as well as all required surrogates, is performed each day of analysis. The RF data from the standard is compared each day against the average RF from the initial calibration for a specific instrument. If the response to a calibration check standard differs from the initial calibration by more than ±20%, or as specified by the method, then investigation and corrective action is performed, including a complete re-calibration if necessary.

Continuing Calibration (CCAL) is checked as described in Pace Analytical SOPs or methods.

6.4 NON-GC/MS CHROMATOGRAPHY CALIBRATION PROCEDURES (i.e., GC and HPLC)

An initial calibration curve consisting of all compounds of interest (plus a calibration blank for certain analyses such as VOCs) is analyzed to define the usable range of the instrument. Calibration is accomplished as best-fit line, quadratic equation, or average response factors (RF). The curve is determined to be linear if the correlation coefficient is $\geq$ 0.995 unless otherwise stated in the method. Linearity may also be determined using calibration factors or response factors. Response factors are calculated for each compound at each concentration level. These RFs are averaged to generate the mean RF for each compound over the range of the standard curve. The curve is determined to be linear if the RSD of the response factors is <20%, or as specified by the method. The mean RF is used to calculate the sample concentration of the compound of interest.

When sample responses exceed the range of the standard curve, the sample is diluted to fall within the range of the standard curve and reanalyzed. Full calibration is not necessary if a calibration check standard validates the initial calibration curve. If the response to a calibration check standard differs from the initial calibration by more than $\pm$15% for any analyte being quantitated, or as specified by the method, then investigation and corrective action is performed, including complete re-calibration, if necessary.

CCAL is checked as described in Pace Analytical SOPs or methods.

Refer to the MRD for initial and continuing calibration procedures and frequency.

6.5 CALIBRATION OF INDUCTIVELY COUPLED ARGON PLASMA SPECTROMETER (ICP) AND ATOMIC ABSORPTION SPECTROPHOTOMETER (AAS)

The ICP and AAS are standardized for the metal analyte of interest by the analysis of a set of calibration standards prepared by diluting a stock solution of known concentration. Working standards are prepared by dilution of the stock standard. For the AAS, the concentration of the calibration standards is chosen so as to cover the working range of the instrument. Subsequently, all sample measurements are performed within this working range. After the working standards have been prepared, they are analyzed on the ICP or AAS and the instrument response is calibrated to provide a direct readout in concentration.

Refer to the MRD for specifics of calibration.

The calibration is accomplished by entering the metal concentration equivalent to the readout in absorbance units (or emission intensity) during analysis of the working standards.

After the initial calibration, the analysis of the working standards is repeated during sample analysis to standardize instrument response during analysis and to confirm the calibration settings. A typical analysis sequence is presented below:

- Working standards are prepared by dilution of a stock standard solution of the metal analyte of interest.

- A calibration curve within the working range of the instrument is established by analysis of three to five working standards. Two-point ICP standardizations are allowed if linear range studies are performed annually.

- An independent standard is analyzed to confirm the calibration settings. If the calibration settings do not confirm, the instrument is re-calibrated.

- Interference check standards as specified by the method are analyzed.

- The samples are analyzed for the metal analyte of interest.

- During sample analysis, a check standard is analyzed to monitor instrument stability. If the analysis indicates that instrument calibration has changed by more than ±10% for ICP or more than ±20% for AAS, the instrument is re-calibrated and the analysis is repeated.

- Following completion of the sample analyses, the check standard and interference check standard are reanalyzed to confirm calibration settings. If calibration settings are confirmed, the analysis is completed. However, if the calibration settings are not confirmed, the problem is corrected and the analyses are repeated.

Written records of all calibrations are filed with the raw data.

7.0 ANALYTICAL PROCEDURES

Pace Analytical laboratories are capable of analyzing a full range of environmental samples from all media, including surface and groundwater, soil, sediment, tissue, and waste. Methodologies are employed with guidance from federal agencies such as EPA, ASTM, USGS, NIOSH and, in certain instances, state regulatory agencies. Table 7.1 is a representative listing of general analytical protocol references. In some situations, Pace Analytical develops and validates methodologies which may be more applicable to a specific problem or objective.

Analytical procedures are detailed descriptions of any and all sample processing, preparation and analysis of samples in the laboratory. All analytical procedures are conducted in strict adherence with written Standard Operating Procedures (SOPs) developed from the references in Table 7.1 that have been reviewed and approved by the Laboratory Operations Manager, the QAO and the General Manager. Additional SOPs may be adapted from other sources or generated in-house as project needs require.

7.1 ANALYTICAL METHODS

Numerous sources of information are available to offer guidance in analytical methods. Selection of the appropriate method is dependent upon data usage and the regulatory requirements during the analysis. Tables 7.1 and 7.2 describe the analytical and QA/QC references routinely used by Pace Analytical. Pace Analytical may modify existing methods based on the following considerations:

- To meet project specific objectives
- To incorporate modifications or improvements in analytical technology
- To comply with changing regulations and requirements
- To address unusual matrices not covered in available methods

Pace Analytical discloses to its clients and regulatory agencies any instances in which modified methods are being used in the analysis of samples.

7.2 PROCEDURE DOCUMENTATION

All processes involved with the production and reporting of analytical data are documented through the use of SOPs.

Pertinent information required to accurately define the procedures followed are delineated in the SOP, or by reference to other controlled documents from the SOP. External references may include instrument or equipment manuals or operating instructions, bench instructions, or published methods.

7.2.1 Elements of the SOP

Each SOP describing analytical methods performed in the laboratory is prepared as specified in the Pace Analytical Standard Operating Procedure for Preparation of Standard Operating Procedures (ALL P 001).

The SOPs are logically organized according to procedure designations commonly known to laboratory personnel. Signatures indicating approval are provided by a supervisor or manager of the applicable section, the Quality Assurance Officer and the General Manager for that particular facility. Approval indicates agreement with the appropriateness and feasibility of the described procedures, and the completeness of the SOP compared to the required elements of the method.

7.2.2 Review, Revision and Distribution of SOPs

See Section 4.1.3.

7.3 METHOD VALIDATION

When non-promulgated methods (i.e. methods other than EPA, NIOSH, ASTM, AOAC, etc.) are required for specific projects or analytes of interest, or when the laboratory develops a method, the laboratory establishes the validity of the method prior to applying it to client samples. Method validity is established by meeting certain criteria for precision and accuracy as established by the data quality objectives specified by the end user of the data.

7.4 COMPLIANCE

Compliance is the proper execution of recognized, documented procedures which are either approved or required. Adherence to these procedures is required in order to provide data products acceptable to a regulatory body of competent jurisdiction in a specific regulatory context. Compliance is separate from, but not inconsistent with, technical scientific quality. Pace Analytical accepts compliance as part of the Pace Analytical corporate definition of quality: "Quality is the *fulfillment of expectations and needs* in all activities, demonstrated by the satisfaction of those we serve." Pace Analytical understands that the expectations of our clients commonly include the assumption that data and reports will satisfy a regulatory purpose and will be found acceptable *and compliant* with regulatory requirements for the performance of tests and generation of data.

7.4.1 Understanding the Regulatory Framework

Compliance is not likely to be achieved in the absence of an understanding of the regulatory framework. Pace Analytical will attempt to ascertain, prior to beginning a project, what regulatory jurisdiction (USEPA, NJDEPE, etc.) pertains to a project; within the regulatory jurisdiction, what body of regulation is meant to be satisfied (RCRA, SDWA, 21E, etc.); and finally, within this context, what protocols are required/expected (CLP, AFCEE, NFESC, ASP, etc.). Pace Analytical interacts with its clients to come to a mutual understanding of all requirements.

7.4.2 Resolving Compliance Contradictions and Hierarchies

It is a common occurrence that multiple regulatory jurisdictions overlap. This causes uncertainty or even contradictions to arise in a work plan. Pace Analytical makes every effort to detect such inconsistencies, and communicates them to clients so that an informed decision is made by the client regarding execution of the project. Similarly, methods and protocols will often be prescribed in a scope of work or QAPP, which either will not achieve stated or implied DQOs or are in conflict with the regulatory requirements. Pace Analytical attempts to detect these inconsistencies, and upon detection, disclose same to the client. Pace Analytical voluntarily accepts a responsibility to provide advice to clients, however, **the primary decision responsibility for this issue remains with the client.**

7.4.3 Disclosure of Noncompliance

It is Pace Analytical policy to disclose in a forthright manner any detected noncompliance that may effect the usability of data produced by Pace Analytical. It is not within our expertise to predict the manner in which a specific regulator or regulatory body will interpret the rules governing analysis. Therefore, Pace Analytical is unable to guarantee compliance. It is Pace Analytical policy that our responsibility begins with a *bona fide* and competent attempt to evaluate potential compliance issues and ends with disclosure of any findings that may be useful to our client in their making the final judgment.

TABLE 7.1

ANALYTICAL PROTOCOLS

- "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act." Federal Register, 40 CFR Part 136, October 26, 1984.
- "Test Methods for Evaluating Solid Wastes: Physical/Chemical Methods." SW-846. Most current edition and update.
- "Methods for Chemical Analysis of Water and Wastes", EPA 600/4-79-020, 1979 Revised 1983, U.S. EPA.
- U.S. EPA Contract Laboratory Program Statement of Work for Organic Analysis,
- U.S. EPA Contract Laboratory Program Statement of Work for Inorganic Analysis,
- "Standard Methods for the Examination of Water and Wastewater". Current Edition APHA-AWWA-WPCF.
- "Annual Book of ASTM Standards", Section 4: Construction, Volume 04.04: Soil and Rock; Building Stones, American Society for Testing and Materials, 1987.
- "Annual Book of ASTM Standards", Section 11: Water and Environmental Technology, American Society for Testing and Materials, 1987.
- "NIOSH Manual of Analytical Methods", Third Edition, 1984, U.S. Department of Health and Human Services, National Institute for Occupational Safety and Health.
- "Methods for the Determination of Organic Compounds in Finished Drinking Water and Raw Source Water", U.S. EPA, Environmental Monitoring and Support Laboratory - Cincinnati (September 1986).
- New York State Department of Environmental Conservation. Analytical Services Protocol, September, 1989 (revised December 1991).

TABLE 7.2

ANALYTICAL REFERENCES

1. Handbook for Analytical Quality Control in Water and Wastewater Laboratories, U.S. EPA 600/4-79-019, March, 1979.

2. Federal Register, 40 CFR Part 136, October 26, 1984.

3. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition & Final Updates One and Two, U.S. EPA, revised September, 1994 and current promulgated editions.

4. Quality Assurance of Chemical Measurements, Taylor, John K.; Lewis Publishers, Inc. 1987.

5. Standard Methods for the Examination of Water and Wastewater, APHA, AWWA, WPCF: Current Edition.

6. NIOSH Manual of Analytical Methods, U.S. Department of Health, Education, and Welfare; Second Edition, 1977.

7. Methods for Non-conventional Pesticides Chemicals Analysis of Industrial and Municipal Wastewater, Test Methods, EPA-440/1-83/079-C.

8. Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79--020, 1983.

9. The Determination of Inorganic Anions in Water by Ion Chromatography - Method 300.0 Test Method, EPA-600/4-84-017. March, 1984.

10. Environmental Measurements Laboratory (EML) Procedures Manual, HASL-300, US DOE, February, 1992.

11. Requirements for Quality Control of Analytical Data, HAZWRAP, DOE/HWP-65/R1, July, 1990.

12. Requirements for Quality Control of Analytical Data for the Environmental Restoration Program, Martin Marietta, ES/ER/TM-16, December, 1992.

13. Quality Assurance Manual for Industrial Hygiene Chemistry, AIHA, 1988.

14. National Environmental Laboratory Accreditation Conference. Constitution, Bylaws, and Standards, June, 2000.

8.0 DATA REDUCTION, VERIFICATION AND REPORTING

Data reduction, verification and reporting are the processes that result in the delivery of quantitative analytical data to the data user. These processes include calculation of raw data into final concentration units, reviewing results for accuracy and assembly of the technical report for delivery to the data user.

All analytical data generated within the Pace Analytical laboratories undergo a well-defined, well-documented multi-tier review process before being reported to the client. The following describes procedures employed at Pace Analytical for translating raw analytical data into accurate, finished sample reports and describes data storage policies. Sample and data flow through the laboratory is shown in Figure 8.1

8.1 DATA REDUCTION

When "raw data" is manually generated by an analyst, it is recorded in either a bound notebook (run logbook), or copies of the computer printouts are appropriately labeled and stored in sequence logbooks. The term "raw data" can be a compilation of many items including, but not limited to, computer printouts, calculation sheets, charts or graphs, chromatograms, method number references, final results and analyst's initials and date of analysis. Logbooks and other bench records are kept in accordance with each laboratory's Standard Operating Procedure on documentation practices (this may also include the use of electronic logbooks). The primary analyst is responsible for the initial reduction and review of the data. This includes entering analytical data into the EPIC Laboratory Information Management Systems; confirming compliance with required methodology; checking the calculations used; checking quality control data against known criteria; and noting any discrepancies that occurred both in the necessary logbooks and as a footnote or narrative in EPIC. The primary analyst then compiles the initial data packet for data verification. This compilation may include the following information as long as sufficient documentation is present for the data reviewer: chromatograms or strip-chart recordings, other computer printouts, chain-of-custody copies if available, and logbook copies. Some agencies or clients require different levels of data reporting. For these special levels, the primary analyst may also need to compile additional project information such as initial calibration data or extensive spectral data before the data package goes to the verification step.

8.2 DATA VERIFICATION

Data verification is the process of examining data and accepting or rejecting it based on pre-defined criteria. This review step is designed to ensure that the reported data are free from calculation and transcription errors, that quality control parameters are evaluated, and that any discrepancies are properly documented. (The EPIC computer system refers to this verification as a **validation** step.)

Analysts performing the analysis and subsequent data reduction have the primary responsibility for the quality of the data produced. The primary analyst initiates the data validation process by reviewing and accepting the data, provided QC criteria have been met for the samples being reported. Data review checklists are used to document the data review process.

The completed data package is then sent to the Group Supervisor or designated reviewer. This reviewer provides a technical assessment of the data package and technical review for accuracy according to methods employed and laboratory protocols. This involves a quality control audit for use of the proper methodology and detection limits, compliance to quality control protocol and criteria, presence and completeness of required deliverables, and accuracy of calculations and data quantitation. Group Supervisors also review analyst generated calculations.

For data that are reduced via computer, calculations are checked by the analyst (or designee) assigned to this task at a frequency designed to assure that the data reductions are valid. The results are either manually transferred to a standard reporting form or reported via computer generation of forms.

Once the data have been technically reviewed and approved, authorization for release of the data from the analytical section is indicated by initialing and dating the data review checklist or otherwise initialing and dating the data.

The Operations or Project Manager examines the report for method appropriateness, detection limits and QC acceptability. Any deviations from the referenced methods are checked for documentation and validity, and QC corrective actions are reviewed for successful resolution.

Use of checklists ensures that all data are systematically handled and no steps are omitted. Checklists are reviewed and are retained and accessible should they need to be referenced at a later date.

8.3 DATA REPORTING

All data segments pertaining to a particular Pace Analytical Laboratory Project Number are delivered to the Client Services Department (Project Manager) for assembly into the final report format. All points mentioned during technical and QC review are included in a narrative if it is deemed to impact the quality of the data.

After verifying the report's completeness and accuracy, the Project Manager signs the cover letter or authorization line within the report indicating acceptance of the report.

Final reports are prepared according to the level of reporting required by the client. A standard Pace Analytical final report consists of the following components:

1. A title which designates the report as "Final Report", "Laboratory Results", "Certificate of Results", etc.
2. Name and address of laboratory (or subcontracted laboratories, if used).
3. Phone number and name of laboratory contact where questions can be referred.
4. A unique number for the report (project number). The pages of the report shall be numbered and a total number of pages shall be indicated (usually in the cover letter.
5. Name and address of client and name of project (if applicable).
6. Unique identification of samples analyzed (including client sample numbers).
7. Identification of any sample which did not meet acceptable sampling requirements

(from NELAC or other governing agency), such as improper sample containers, holding times missed, sample temperature, etc.

8. Date and time of collection of samples, date of sample receipt by the laboratory, dates of sample preparation and analysis, and times of sample preparation and analysis when the holding time for either is 72 hours or less.
9. Identification of the test methods used.
10. Identification of sampling procedures if sampling was conducted by the laboratory.
11. Deviations from, additions to, or exclusions from the test methods. These can include failed quality control parameters, deviations caused by the matrix of the sample, etc., and can be shown as a case narrative or as defined footnotes to the analytical data.
12. Identification of whether calculations were performed on a dry or wet-weight basis.
13. Reporting limits used.
14. Final results or measurements, supported by appropriate chromatograms, charts, tables, spectra, etc.
15. If required, a statement of the estimated uncertainty of the test results.
16. A signature and title of person accepting responsibility for the content of the report (can be an equivalent electronic identification) and date report was issued.
17. If necessary, a statement clarifying that the results of the report relate only to the samples tested or to the samples as they were received by the laboratory.
18. If necessary, a statement indicating that the report must not be reproduced except in full, without the written approval of the laboratory.
19. Identification of all test results provided by a subcontracted laboratory or other outside source.
20. Identification of results obtained outside of quantitation levels.

Any changes made to a final report shall be designated as a "Supplement" or equivalent wording. For higher levels of data reporting, a copy of all raw data is sent to the client along with a final report of results. When possible, the Pace Analytical laboratory will provide electronic data deliverables (EDD) as required by contracts or upon client request.

8.4 DATA ARCHIVE

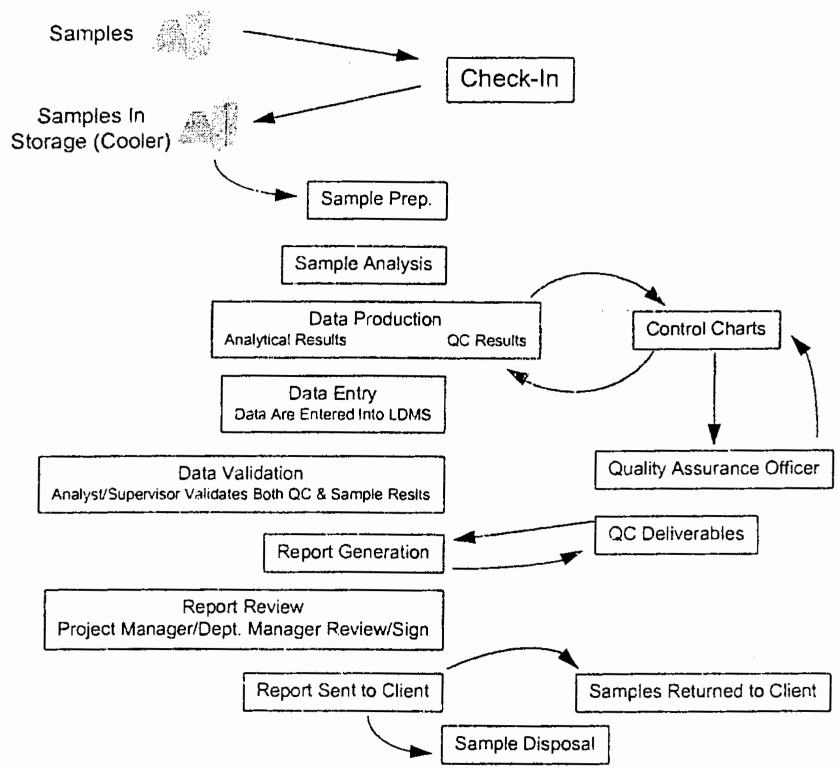
All records compiled by Pace Analytical labs are maintained, stored and secured by the Quality Assurance Officer or by a designated Data Archivist. These records can include client data reports, certificates pertaining to calibration and maintenance of equipment, raw data from instrumentation, quality control documents and logbooks. These records are retained in order to provide for possible historical reconstruction of data. Records are archived and maintained by the laboratory for a period of time determined by the specific state, federal, contractual and accreditation requirements. Access to archived data is kept to a minimum, with the Data Archivist maintaining the archive documentation in a secure, fireproof (if possible) location. Some laboratories archive their data in an off-site facility and the data archivist will keep a record of this archival as well. Records that are computer generated have either a hard copy or electronic backup copy.

In the event of a change in ownership, accountability or liability, reports of analyses performed pertaining to accreditation will be maintained by the acquiring entity for a minimum of five years. In the event of bankruptcy, laboratory reports and/or records will be transferred to the client and/or the appropriate regulatory entity.

8.5 RESPONSE TO COMPLAINTS

The Pace Analytical laboratory that conducted analyses for the client recognizes the importance of its timely response to inquiries regarding the laboratory's work for samples and projects. The laboratory will respond to inquiries as rapidly as possible as part of its corrective action plan. The Pace Analytical laboratory that originally received samples from the client is considered the primary contact for all data inquiries when subcontract or other Pace Analytical laboratories are used for analyses.

FIGURE 8.1
Laboratory Sample And Data Flow Schematic



9.0 QUALITY CONTROL PROCEDURES

A quality control (QC) program is a systematic process that controls the validity of analytical results by measuring the accuracy and precision of each method and matrix, developing performance-based control limits using these limits to detect errors or out-of-control events, and requiring corrective action measures to prevent or minimize the recurrence of these events. QC procedures are implemented to ensure that sample data meet the quality objectives of the laboratory and the client.

This section addresses the specific QC procedures applied to representative analytical methods performed at Pace Analytical.

9.1 LABORATORY QUALITY CONTROL SAMPLES AND MEASUREMENTS

The results of quality control samples created in the laboratory represent estimates of accuracy and precision for the preparation and analysis steps of sample handling. This section describes the types of quality control samples used to assess the quality control procedure. The necessary SOPs are followed for preparing reagents or solutions for these QC measures.

9.1.1 Method Blank

A method blank, or laboratory reagent blank, is a volume of deionized or distilled laboratory water for water samples or a purified solid matrix for soil/sediment samples, carried through the entire analytical procedure. Blank analysis allows any method interferences caused by contaminants in solvent, reagents, glassware or sample processing hardware to be examined and verified. The volume or weight of the blank must be approximately equal to the sample volume or weight processed. Optimally, a method blank should contain no greater than five times (5X) the method detection limit, or reporting limit where applicable, for common laboratory solvents and phthalate esters; or less than the detection (or reporting) limit for all other parameters unless otherwise specified in the method or project QA plan. Method blank results are maintained with other QC data and included in the final report at the client's request.

Method blank frequency is as follows:

Organic: The laboratory prepares and analyzes one method blank per analytical batch of 20 samples or less, or every time samples are extracted, whichever is more frequent.

Inorganic: At least one method blank is prepared and analyzed with every group of 20 samples, or with each batch (a group of samples prepared at the same time, e.g. daily) of samples digested, extracted, prepared or directly analyzed, whichever is more frequent.

9.1.2 Laboratory Control Spikes/Laboratory Control Spike Duplicates (LCS/LCSD)

The LCS consists of an aliquot of deionized/distilled laboratory water for liquid matrices and purified solid matrix for soils. If no such soil is available, laboratory pure water is substituted. The aliquot is injected with a known concentration of all the analytes of interest. LCSs are prepared at a rate of at least one per analytical batch.

The LCS provides an estimate of bias based on recovery of the compounds from a clean matrix. These QC measures provide evidence that the lab is performing the method within accepted guidelines without matrix interferences.

An LCS/LCSD pair is substituted when sufficient sample volume is not available to prepare an MS/MSD pair.

9.1.3 Matrix Spikes/Matrix Spike Duplicates (MS/MSD)

Matrix spikes are similar to LCSs except that the analyte spikes are added to a second and third separate aliquot of the same client sample within an analytical batch. This enables the lab to assess matrix effects and field conditions. MS/MSDs are routinely prepared at a frequency of 5% (one set per twenty samples) when adequate sample volume is provided.

9.1.4 Surrogates

Surrogates are added to all organic samples, method blanks, LCS and MS prior to extraction and analysis. They provide an estimate of bias based on recovery of chemical compounds similar to target analytes but not occurring in nature. This aids in detecting any effects from the sample matrix and/or field conditions.

9.1.5 Internal Standards

Internal standards are analytes having surrogate characteristics but are added to each sample within a batch just prior to analysis. These are primarily used for quantitation. It corrects for bias or change in instrument performance from sample to sample, incorporating matrix effects associated with the analytical process only.

9.1.6 Sample Duplicate

A sample duplicate is prepared by homogenizing and splitting the sample into two equal portions before the sample preparation process. It measures precision associated with preparation through analysis and is prepared and analyzed at a rate of one per analytical batch. The MS/MSD may fulfill this function and provide a measure of overall precision.

9.1.7 Accuracy Measurements

Accuracy reflects the degree to which the measured value approximates the actual or "true" value for a given parameter and reflects the influence of systematic biases in the measurement. It is expressed as % Recovery. For the LCS, surrogates, and method blanks, the calculation is as follows:

% Recovery = (SR / SA) * 100

Where: **SR** = the determined concentration
SA = the spiked ("true") concentration

For MS/MSD, the percent recovery is calculated as:

% Recovery = (SSR-SR)/SA * 100

Where: **SSR** = the spiked sample determined result
SR = original sample determined result
SA = the spiked ("true") concentration

9.1.8 Precision Measurements

Precision measures the randomness associated with an analytical measurement and reflects the inherent variability in that measurement system. The comparison of the values determined for a sample and its duplicate (MS/MSD) is expressed as relative percent difference (RPD). This calculation is as follows:

$$\textbf{RPD} = \frac{|S-D|}{[(S+D)/2]} * 100$$

Where **S** = original sample result
D = duplicate result

9.2 SAMPLE COLLECTION QUALITY CONTROL

Quality control is an integral part of sample collection as well as laboratory operations. Sample collection protocols must include checks to ensure that the sample collected is representative of the field site and free from sampling-related contamination or bias. Although different laboratory procedures will be used to analyze for the various parameters of interest, certain general QC procedures (described below) are applicable to most sampling methods. The types and frequency of collection for each of these field QC samples are detailed in each project's sampling and analysis plan.

9.2.1 Field Blanks

Field blanks are QC samples consisting of blank water that are prepared in the field. This serves to check for potential contamination that may be present in the environment where field samples are collected.

9.2.2 Trip Blanks

Trip blanks are similar to field blanks except that they are prepared in the laboratory before the sampling event. These blank samples accompany the other sample containers to the field and then accompany the collected samples back to the laboratory. Trip blanks serve to check for potential contamination that samples and sample containers may be exposed to during transport to and from the field.

9.2.3 Equipment Rinsate Blanks

Equipment rinsate blanks serve to check the adequacy of equipment cleaning between successive sample collections. These rinsates use blank water provided by the laboratory. Inadequate cleaning of sampling equipment after sample collection could result in the contamination of subsequent samples.

9.2.4 Matrix Spike/Matrix Spike Duplicate Samples (MS/MSD)

The field sampling personnel must collect a replicate set of samples such that one set is collected per twenty samples. The duplicate analyses provide information regarding homogeneity, handling, transportation, storage, and analyses.

Laboratory operations must make a conscious effort to request or collect, as part of a field sampling event, a sufficient amount of sample to satisfy the method requirements. Samples selected for MS/MSD which contain limited volume or quantity should be evaluated based on the type of analyses to be performed. This information should be used in conjunction with client interaction to establish whether modifications could be made to the method.

9.3 STANDARDS

The term "standard" applies to any analyte solution of known concentration that is traceable to a certified reference material. This includes calibration standards and spiking solutions.

Upon receipt, all purchased standard reference materials (neat and stock) are recorded into section-specific standard logbooks or databases. The standard logbook or database entries include Pace Analytical's unique ID, the name of the neat compound or solution, manufacturer, manufacturer's lot numbers, certified purity, receipt date and expiration date. Subsequent preparations of stock, intermediate, and working solutions are also documented in a standard preparation logbook. These entries must include all discrete measurements made during preparation, sources of materials, solvent(s), solvent lot number, preparation date, expiration date, preparer's initials, and a Pace Analytical standard ID number.

The standard vial should have a reference label affixed containing the following information (if space permits):

- Standard ID #
- Standard name
- Preparation date
- Preparer's initials
- Solvent and lot number
- Concentration
- Expiration date

All primary reference standards and standard solutions are purchased from reliable commercial sources. NIST-traceable standards are preferred when available. ASTM or equivalent specifications are acceptable when NIST-traceable are not available. Certification records of all standards received are retained.

Second-source reference standards and standard solutions are purchased from a different supplier than the primary standard. If a second supplier is not available, the second-source standard can be prepared from a different lot number of the sample composition from the same supplier.

Prior to utilization, newly prepared standard solutions (surrogate, calibration, spiking) are verified against another known standard prepared from another source. The verification data is maintained on file in the respective area.

9.4 CONTROL CHARTS

Control charts are quality control tools graphically displaying certain QC parameters over time. Accuracy and precision control charts are generally maintained for each method. However, for certain methods tabulated control limits are used to monitor acceptability of quality control measurements.

9.4.1 Limits

Control limits express the outer limits of accepted method variability. Control limits are reviewed periodically against performance. Based on statistical considerations, an evaluation is made to determine whether the control limits need to be revised.

Unless otherwise stipulated in a particular method or program, control limits are statistically derived from laboratory-generated data. They are based upon ± 3 sigma of the mean determination (i.e. 99% confidence interval). The use of hard-coded limits not statistically derived from current laboratory-generated data (e.g., CLP limits) is limited to programs which specifically permit their application.

Control limits are updated annually (at a minimum) or once every 20 data points (at a maximum). Tabulated control limits are available and followed by all analysts performing the associated test. However, control charts are the preferred mechanism for monitoring quality control measurements on a real-time basis.

9.4.2 Accuracy Control Charts

Accuracy charts are maintained for surrogate and LCS recovery. Each sample is identified by its Pace Analytical sample number and its analysis date. This is plotted onto a graph with the sample ID and percent recovery serving as the X and Y-axis, respectively.

9.4.3 Precision Control Charts

In cases where precision charts are maintained, the relative percent difference is plotted on the graph with the number of data points on the X-axis and the RPDs on the Y-axis. These are identified by the analysis dates and Pace sample ID number.

9.4.4 Control Chart Evaluation

Plotting and connecting successive data points on control charts enables the laboratory to detect many types of suspicious and out-of-control situations. These events can be determined by monitoring the following: outliers, runs, trends and periodicity. Outliers require immediate corrective action, whereas runs, trends and periodicity are indicators of circumstances that could lead to out of control conditions.

Outliers: A point that falls outside the control limits is classified as an out-of-control event. Whenever an analyte is outside the control limits, corrective action is performed. All calculations are checked, the integrity of the spiking solution is verified, and the instrument and operating conditions are checked to preclude the possibility of malfunction or operator error. After the systems problems have been resolved and control has been re-established, all samples in the analytical batch are reanalyzed for the out-of-control analytes.

Runs: A run is defined as a series of points that line up on one side of the central line (the mean). Any run that has a length of seven points is indicative of a potential abnormality in the process. A run can suggest several potential problems such as a system leak, elevated contamination, or incorrect standard dilution.

Trends: A trend is defined as a series of points that are marked by a continuous rise or fall. Any trend with a length of five points (may vary up to

seven points) is classified as a suspicious event. A trend may indicate a change in instrument sensitivity due to conditions such as a dirty source or injection port or standard degradation.

Periodicity: Periodicity is a term used to describe a recurring pattern of change over equal intervals. This occurrence may be on any length or amplitude; thus, careful observation of the control chart is necessary.

10.0 QUALITY ASSURANCE AUDITS AND PERFORMANCE EVALUATIONS

This section describes the program of audits designed to provide feedback about the effectiveness of the laboratory QA/QC systems and discusses the roles and responsibilities of Pace Analytical personnel related to such audits.

10.1 INTERNAL AUDITS

10.1.1 Quality Assurance Officer

The QAO is responsible for designing and/or conducting (with optional assistance) QA performance and systems audits. Since QA audits represent an independent assessment of laboratory functions, the auditor must be functionally independent from laboratory operations to ensure objectivity. The auditor must be familiar enough with the objectives, principles, and procedures of laboratory operations to be able to perform a thorough and effective evaluation. The QAO evaluates audit observations and verifies the completion of corrective actions.

10.1.2 Scope and Frequency of Internal Audits

Internal systems audits are conducted yearly at a minimum. The scope of these audits include evaluation of specific analytical department or a specific quality-related system as applied throughout the laboratory.

Examples of system-wide elements that can be audited include:

- Quality Systems documents, such as Standard Operating Procedures and Quality Manual.
- Personnel and training files.
- General laboratory safety protocols.
- Chemical hygiene practices, such as labeling of reagents, solutions, standards, and associated documentation.
- Documentation concerning equipment and instrumentation, calibration/ maintenance records, operating manuals.
- Sample receipt and management practices.
- Analytical documentation, including any discrepancies and corrective actions.
- General procedures for data security, review, documentation, reporting and archiving.

When the operations of a specific department are evaluated, a number of additional functions are reviewed including:

- Method detection limit studies
- Internal chain-of-custody documentation
- Documentation of standard preparations

- Control charts

Certain project may require an internal audit to ensure laboratory conformance to site work plans, sampling and analysis plans, QAPP, etc.

10.1.3 Internal Audit Reports and Corrective Action Plans

A full description of the audit, including the identification of the operation audited, the date(s) on which the audit was conducted, the specific systems examined, and the observations noted are summarized in an internal audit report. Although other personnel may assist with the performance of the audit, the QAO writes and issues the internal audit report identifying which audit observations are deficiencies that require corrective action.

Once completed, the internal audit report is issued jointly to the Laboratory General Manager and the manager(s)/supervisor(s) of the audited operation(s). The responsible manager(s)/supervisor(s) responds with a plan to correct all of the deficiencies cited by the due date specified in the audit report. Each response must include timetables for completion of all proposed corrective actions.

The QAO reviews the audit responses. If the response is accepted, the QAO uses the action plan(s) and timetable(s) as a guideline for verifying completion of the corrective action(s). If the QAO determines that the audit response does not adequately address the correction of cited deficiencies, the response will be returned for modification.

To complete the audit process, the QAO performs a re-examination of the areas where deficiencies were found to verify that all proposed corrective actions have been implemented. An audit deficiency is considered closed once implementation of the necessary corrective action has been verified. If corrective action cannot be verified, the associated deficiency remains open until that action is completed.

10.2 EXTERNAL AUDITS

Pace Analytical is audited as required by regulatory agencies to maintain laboratory certifications, and by various commercial clients.

Audit teams external to the company review the laboratory to assess the existence of systems and degree of technical expertise. QA staff hosts the audit team and assist in facilitation of the audit process. Generally, the auditors will prepare a formalized audit report listing deficiencies observed and follow-up requirements for the laboratory. In some cases, items of concern are discussed during a debriefing convened at the end of the on-site review process. The laboratory staff and supervisors develop corrective action plans to address any deficiencies with the guidance of the QAO. The Laboratory Manager provides the necessary resources for staff to develop and implement the corrective action plans. The QAO collates this information and provides a written report to the audit team. The report contains the corrective action plan and expected completion dates for each element of the plan. The QAO follows-up with the laboratory staff to ensure corrective actions are implemented.

10.3 PERFORMANCE EVALUATION/PROFICIENCY TESTING PROGRAM

10.3.1 NELAP Proficiency Testing Program

Pace Analytical laboratories participate in the NELAP-defined proficiency testing program. Proficiency Test (PT) are obtained from NIST-approved providers and analyzed and reported at a minimum of two times per year for the relevant fields of testing.

For PT quantitations evaluated as being outside the acceptance ranges, the responsible manager(s)/supervisor(s) performs investigations and reports are the results. The reports are reviewed by the QAO, then forwarded to the various accreditation agencies, as required, for their review.

10.3.2 Other Performance Evaluation (PE) Studies

Other PE samples may be performed by Pace Analytical in conjunction with a specific program or contract.

10.4 MANAGER REVIEW

A manager review of Quality Systems is performed on an annual basis. This allows for assessing program effectiveness and introducing changes and/or improvements. Such items discussed include manager reports, audit outcomes, proficiency test results, incoming work types, client feedback and corrective actions. Findings from the manager's review are maintained by the QAO.

11.0 PREVENTIVE MAINTENANCE

The objectives of Pace Analytical's preventive maintenance program are twofold: to establish a system of instrument care that maintains instrumentation and equipment at required levels of calibration and sensitivity, and to minimize loss of productivity due to repairs. The program includes a system for documenting all routine and non-routine instrument maintenance and repairs.

11.1 MAINTENANCE RESPONSIBILITIES

The Laboratory Operations Manager and department Manager/Supervisors are responsible for providing technical leadership to evaluate new equipment, solve equipment problems and coordinate instrument repair and maintenance. The Analysts have a primary responsibility to perform routine maintenance.

To minimize downtime and interruption of analytical work, preventive maintenance is routinely performed on each analytical instrument.

11.2 MAINTENANCE DOCUMENTATION

All routine and non-routine instrument maintenance is documented in maintenance logbooks assigned to each instrument. These records include the following:

1. The name of the equipment
2. The manufacturer's name, type, and serial number
3. Approximate date received and date placed into service
4. Current location in the laboratory
5. Condition when received (new, used, etc.)
6. Copy of any manufacturer's manuals or instructions
7. Dates and results of calibrations and next scheduled calibration (if known)
8. Details of past maintenance activities, both routine and non-routine
9. Details of any damage, modification or major repairs

When maintenance is performed to repair an instrument problem, depending on the initial problem, demonstration of return to control may be satisfied by the successful analysis of a reagent blank or continuing calibration standard. The entry must include a summary of the results of that analysis and verification by the analyst that the instrument has been returned to an in-control status. In addition, each entry must include the initials of the analyst making the entry, the dates the maintenance actions were performed, and the date the entry was made in the maintenance logbook, if different from the date(s) of the maintenance.

11.3 SPARE PARTS

Department manager/supervisors are responsible for maintaining an adequate inventory of spare parts required to minimize equipment downtime. This inventory includes parts and supplies that:

- are subject to frequent failure,
- have limited useful lifetimes, or
- cannot be obtained in a timely manner should failure occur.

12.0 CORRECTIVE ACTION

This section describes the system that is implemented for the documentation and correction of abnormalities encountered during sample handling and analysis.

When errors, deficiencies, unusual occurrences, or out-of control situations exist, the QA program provides systematic procedures, referred to as "corrective actions", to resolve problems and restore proper functioning of the analytical system. Within Pace Analytical, a distinction is made between "out-of-control events" and "unusual occurrences" for the purposes of requiring corrective actions.

An out-of-control event is any event where the evaluation criteria are beyond the acceptance limits established for laboratory operation by Pace Analytical SOPs, EPA methods, or client specific contracts or protocols. This can be due to data outside of the accepted bounds for accuracy and/or precision because of matrix contamination, or improper instrument calibration or maintenance.

An unusual occurrence is a one-time event such as a storm event impacting power. Both out-of-control events and unusual occurrences are formally documented. Within Pace Analytical, the formal documentation reports may be identified with different designations including Corrective Action Report (CAR), Quality Action Log (QA Log), Non-conformance Report (NCR), Remedial Action Record (RAR), or Discrepancy Report (DR). Each of these reports serves the purpose of documenting whenever either type of event is noted. Collectively these reports are referred to as Discrepancy documents.

12.1 DISCREPANCY DOCUMENTATION

Discrepancy documentation may be initiated by an Analyst, Department Manager/Supervisor, Project Manager, or other laboratory personnel. The Discrepancy documentation is used to document a specific problem or deficiency noted during sample handling or analysis. Depending on the specific problem or deficiency, corrective actions may be taken by the Analyst, Department Manager/Supervisor, Project Manager, or other laboratory personnel. Since problems encountered with sample analysis often have the potential to impact data quality, appropriate corrective action is frequently determined in communications between the laboratory Project Manager and the client.

Each Discrepancy documentation requires the initials of the person documenting the problem as well as those of any person documenting additional information or corrective action. Each record is then reviewed and initialed by the department Manager/Supervisor. If the deficiency or problem impacts client sample data, the Department Manager/Supervisor passes the documentation directly to the QAO and appropriate Project Manager for their review and follow-up.

The documentation describes the actions taken at each step of the review process. Evidence of return to control must also be documented. Once documentation of the problem, corrective action, and return to control is complete, the documentation is forwarded to the QAO for review. QA review is documented with the QAO's initials and the completed original record is either passed back to the appropriate Project

Manager to be filed in the client project file or is filed in the QA files, depending on the nature of the nonconformance.

12.2 OUT-OF-CONTROL-EVENTS

Out-of-control events associated with the statistical analysis and review of data are easy to identify. The Analyst generating the data is responsible for checking the results against the established limits. Any deviations are immediately addressed. If data are outside accepted limits, the Analyst immediately notifies the responsible Manager/Supervisor. If the situation cannot be corrected to prevent an out-of-control condition, the Supervisor/Manager shall notify the Operations Manager and the Quality Assurance Officer. The Operations Manager and Department Managers/Supervisors are responsible for identifying the source of the problem and initiating corrective action. Completion of corrective action is evidenced by the return of the procedure to prescribed acceptable limits.

Events not causing an immediate obvious effect on data quality are more difficult to identify. Such events could be samples stored at an incorrect temperature or held beyond prescribed holding times, or improper maintenance of records. Everyone in the laboratory is responsible for reporting "system" problems. Analysts must report out-of-control events to their Manager/Supervisor, who should then in turn report the situation to the Operations Managers and Quality Assurance Officer. Corrective action is again the ultimate responsibility of the Operations Manager and the Department Managers/Supervisors. They review and approve the action taken.

If an out-of-control event does occur during analysis the analyst must describe, on the corrective action report, the event, the investigative and corrective actions taken, the cause of the event, and notify the QAO. In some cases, investigation of an out-of-control event will reveal no problems. In such cases, only the event and the investigative action are recorded.

The investigative action taken is somewhat dependent on the analysis and the event. However, listed below is a progression of steps which are taken to find the cause of an out-of-control event:

- Check calculations to ensure there are no errors
- Check standard and spiking solutions for degradation or contamination
- Check instrument performance

If the problem is determined to be the standards or instrument performance, the analyst must recalibrate or retune the instrument before reanalyzing the sample extracts affected. If the out-of-control condition is still not corrected, the samples may require reextraction and reanalysis or data qualification.

It is occasionally necessary to qualify data when the accompanying quality control data are not within established performance criteria. The qualifying of data alert the data end user to the fact that the precision and accuracy of the data produced may not fulfill the data quality objectives (DQOs) for that particular project.

12.3 QUALITY ASSURANCE PROJECT PLAN EXCEPTIONS

Due to the unknown nature of environmental samples prior to analysis, Pace Analytical has minimal control over analytical and quality control complications which arise from unique sample matrix conditions. These conditions may include such items as: highly concentrated samples containing target compounds of interest and/or non-target components; extremes in sample pH, viscosity, and solubility; and high organic content (both natural and synthetic). Each of these conditions presents a variety of challenges to the laboratory.

Most often these extremes in sample matrix composition require the laboratory to employ dilution techniques in order to change the sample concentration so it can be analyzed by the desired protocol. Unfortunately, dilution techniques raise reporting limits (RLs) and often adversely impact the surrogate standard and matrix spiking acceptance criteria.

The laboratory has the responsibility to clearly identify cases where matrix interferences preclude the generation of "compliant" data. This is done by demonstrating through reproducibility (i.e., reanalysis of the affected sample) that the quality control measurement failure resulted from unique sample matrix conditions beyond the control of laboratory, and not as a result of laboratory error. For example, in situations where the surrogate standard recoveries fall outside of control limits, samples are re-extracted and/or re-analyzed. Similar "non-compliant" results in the reanalysis indicate that it is something inherent to the sample that prevented the laboratory from reporting results deemed method compliant under data validation criteria.

Analytical projects containing particularly "dirty" samples (i.e., highly contaminated) will often fail to meet pre-established QA completeness goals (set forth in the QAPP) when prior site history does not reveal the potential for excessive values. Again, while the laboratory performs all analytical testing by the prescribed protocols, the results obtained may not meet validation criteria as a result of elevated RLs or the frequency at which surrogate and matrix spikes failed to meet acceptance limits. In cases where the laboratory is unable to meet QC criteria because of sample matrix complications beyond their control, results which are flagged "qualified" or "rejected" by data validation guidelines are often still "useable" by the end user of the data.

Pace Analytical is committed to adhering to method requirements and program quality control applications as established by clients and regulatory agencies and will work rigorously to provide data which is of the highest quality possible. However, the uncertainties associated with environmental samples do not allow Pace Analytical to assume responsibility for conditions beyond our reasonable control which directly impact the "validity" versus usability of the associated analytical data.

13.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

An objective of the Pace Analytical quality assurance program is to ensure that an operational system is in place which enables management to determine the quality of all data produced within the laboratory system. An essential component of the system is the communication via various pathways, and feedback mechanisms used to ensure that management obtains quality information promptly and consistently. To achieve this objective, Pace Analytical employs informal and formal reporting processes. This information enables Pace Analytical to take corrective action promptly when required. Reporting occurs at the following frequency.

- On-going interaction between staff and management.
- Daily meetings at the operations level.
- Weekly meeting involving upper management.
- Monthly meetings involving all Pace Analytical QAOs and the Corporate Director of Quality.
- Quarterly written status reports to upper management.
- Internal departmental audit reports as required.

The Quality Assurance Officer is responsible for preparing reports to management indicating effectiveness of the laboratory Quality Assurance Program.

13.1 MANAGEMENT REVIEW

The Quality Assurance Officer will issue a report of QA activities and findings on a regular basis to the General Manager. The status report will include:

- Results of internal systems or performance audits
- Corrective Action activities
- Discussion of QA issues raised by clients
- Results of third party or external audits
- Status of laboratory certifications
- Other significant events
- Performance Evaluation/Proficiency Test Sample Results
- Results of internal laboratory review activities
- Results of internal data review activities
- Results of Proficiency Evaluation studies
- Results of state certification applications
- Summary of holding time overruns and data qualification
- Method detection limit study status
- Training activity summary
- SOP review/revision summary

Any laboratory employee may present changes to the QAO via communication with their Operations Manager.

13.2 QUARTERLY QUALITY SYSTEMS REPORTS TO MANAGEMENT

Quarterly reports are provided by the Quality Assurance Office staff to the Corporate Quality Office and the General Manager. The report summarizes quality assurance activities including details of corrective actions recommended or implemented, internal and external audit results, status of performance evaluation samples, certification status, training activities and SOP revision status.

14.0 GLOSSARY

Accuracy:	The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components that are due to sampling and analytical operations; a data quality indicator.
Aliquot:	A measured portion of a sample taken for analysis.
Analyte:	The specific entity an analysis seeks to determine.
Batch:	Environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A preparation batch is composed of one to 20 environmental samples of the same NELAC-defined matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours. An analytical batch is composed of prepared environmental samples (extracts, digestates or concentrates) that are analyzed together as a group. An analytical batch can include prepared samples originating from various environmental matrices and can exceed 20 samples.
Blank:	A sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results.
Blind Sample:	A sub-sample for analysis with a composition known to the submitter. The analyst/laboratory may know the identity of the sample but not its composition. It is used to test the analyst's or laboratory's proficiency in the execution of the measurement process.
CRDL:	Contract required detection limit.
CRQL:	Contract required quantitation limit.
Calibration:	To determine, by measurement or comparison with a standard, the correct value of each scale reading on a meter, instrument, or other device. The levels of the applied calibration standard should bracket the range of planned or expected sample measurements.
Calibration Curve:	The graphical relationship between the known values, such as concentrations, or a series of calibration standards and their instrument response.
Chain-of-Custody:	(COC) A record that documents the possession of samples from the time of collection to receipt in the laboratory. This record generally includes the number and type of containers, the mode of collection, the collector, the time of collection, the preservation, and the requested analyses.

Confirmation: Verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited to:

- second-column confirmation
- alternate wavelength
- derivitization
- mass spectral interpretation
- alternative detectors
- additional cleanup procedures

Comparability: Comparability is a qualitative parameter expressing the confidence with which one data set can be compared to another. Comparable data are produced through the use of standardized procedures and techniques.

Completeness: Measure of the amount of valid data obtained from a measurement system compared to the amount expected to be obtained under normal conditions. The equation for completeness is:

$$\frac{\text{\# of data points obtained}}{\text{\# of data points expected}} * 100 = \%\ \text{completeness}$$

Calibration Verification: The process of analyzing standards periodically to verify the maintenance of calibration of the analytical system.

Control Chart: A graphical representation of test results with respect to time or sequence of measurement, together with limits within which they are expected to lie when the system is in a state of statistical control.

Control Limit: A range within which specified measurement results must fall to signify compliance. Control limits may be mandatory, requiring corrective action if exceeded, or advisory, requiring that nonconforming data be investigated and flagged.

Corrective Action: The action taken to eliminate the causes of an existing nonconformity, defect, or other undesirable situation in order to prevent recurrence.

Data Quality Objective: (DQO) Systematic strategic planning tool based on the scientific method that identifies and defines the type, quality, and quantity of data needed to satisfy a specified use.

Data Reduction: The process of transforming raw data by arithmetic or statistical calculations, standard curves, concentration factors, etc., and collation into a more usable form.

Demonstration of Capability: A procedure to establish the ability of the analyst to generate acceptable accuracy.

Detection Limit (DL) The lowest concentration or amount of the target analyte that can be identified, measured and reported with confidence that the analyte concentration is not a false positive value. See Method Detection Limit.

Dry Weight:	The weight of a sample based on percent solids. The weight after drying in an oven at a specified temperature.
Duplicate_ (Replicate)Analysis:	The measurement of the variable of interest performed identically on two or more sub-samples of the same sample within a short interval of time.
Environmental Sample:	A representative sample of any material (aqueous, non-aqueous, or multimedia) collected from any source for which determination of composition or contamination is requested or required. Environmental samples can generally be classified as follows: Surface Water and Ground Water Drinking Water - Delivered (treated or untreated) water designated as potable water. Water/Wastewater - Raw source waters for public drinking water supplies, ground waters, municipal influents/effluents, and industrial influents/effluents. Sludge - Municipal sludges and industrial sludges. Soil - Predominately inorganic matter ranging in classification from sands to clays. Waste - Aqueous and non-aqueous liquid wastes, chemical solids, and industrial liquid and solid wastes.
EPIC:	(Environmental Project Information Control) LIMS developed by Pace Analytical
Equipment Blank:	A sample of analyte-free media used to rinse common sampling equipment to check effectiveness of decontamination procedures.
Field Blank:	Blank prepared in the field by filling a clean container with pure de-ionized water and appropriate preservative, if any, for the specific sampling activity being undertaken.
Holding Time:	The maximum time that samples may be held prior to analysis and still be considered valid or not compromised.
Homogeneity:	The degree to which a property or substance is evenly distributed throughout a material.
Initial Calibration:	(ICAL) The process of analyzing standards, prepared at specified concentrations, to define the quantitative response, linearity and dynamic range of the instrument to the analytes of interest. Initial calibration is performed whenever the results of a continuing calibration do not conform to the requirements of the method in use or at a frequency specified in the method.

Internal Standards: A known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical method.

Laboratory Control Samples: (LCS) A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amount of analytes. It is generally used to establish intra-laboratory or analyst-specific precision and bias or to assess the performance of all or a portion of the measurement system.

LIMS: Laboratory Information Management System

Lot: A quantity of bulk material of similar composition processed or manufactured at the same time.

MRD: (Minimum Requirements Document) Written guidelines that outline minimum requirements for method compliance.

Matrix: The component or substrate that contains the analyte of interest. For purposes of batch and QC requirement determinations, the following matrix distinctions are used:

Aqueous: any aqueous sample excluded from the definition of Drinking Water matrix or Saline/Estuarine source. Includes surface water, groundwater, effluents, and TCLP or other extracts.

Drinking Water: any aqueous sample that has been designated a potable or potentially potable water source.

Saline/Estuarine: any aqueous sample from an ocean or estuary, or other salt water source such as the Great Salt Lake.

Non-aqueous liquid: any organic liquid with <15% settleable solids.

Biological Tissue: any sample of a biological origin such as fish tissue, shellfish or plant material. Such sample can be grouped according to origin.

Solids: includes soils, sediments, sludges, and other matrices with >15% settleable solids.

Chemical Waste: a product or by-product or an industrial process that results in a matrix not previously defined.

Air: whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas vapor that are collected with a sorbent tube, impinger solution, filter, or other device.

Matrix Spike: (MS) A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available. Matrix spikes are used to determine the effect of the matrix on a method's recovery efficiency.

Matrix Spike Duplicate: (MSD) A second replicate matrix spike prepared in the laboratory and analyzed to obtain a measure of precision of the recovery of each analyte.

Method Blank: A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses.

Method Detection Limit: (MDL) The minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte.

PBMS: (Performance Based Measurement System) a set of processes wherein the data quality needs, mandates or limitations of a program or project are specified and serve as criteria for selecting appropriate test methods to meet those needs in a cost-effective manner.

Precision: A data quality indicator measuring the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms.

Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical and/or biological integrity of the sample.

Proficiency Testing: A means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source.

Protocol: A detailed written procedure for field and/or laboratory operation that must be strictly followed.

QAPP: (Quality Assurance Project Plan) A formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved.

Quality Assurance: (QA) An integrated system of activities involving planning, quality control, quality assessment, reporting and quality improvement to ensure that a product or service meets defined standards of quality with a stated level of confidence.

Quality Control: (QC) The overall system of technical activities whose purpose is to measure and control the quality of a product or service so that it meets the needs of users.

Quality Manual: A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users.

Quality System: A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC.

Random Error: The EPA has established (preamble to 40 CFR Part 136, Vol. 49, No. 209, October 26, 1984) that there is a 5% probability that the results obtained for any one analyte will exceed the control limits established for the test due to random error. As the number of compounds measured increases in a given sample, the probability for statistical error also increases.

Raw Data: Any original factual information from a measurement activity or study recorded in a laboratory notebook, worksheets, records, memoranda, notes, or exact copies thereof that are necessary for the reconstruction and evaluation of the report of the activity or study. Raw data may include photography, microfilm or microfiche copies, computer printouts, magnetic media, including dictated observations, and recorded data from automated instruments. If exact copies of raw data have been prepared (e.g. tapes which have been transcribed verbatim, dated and verified accurate by signature), the exact copy or exact transcript may be submitted.

Reagent Grade: Analytical reagent (AR) grade, ACS reagent grade, and reagent grade are synonymous terms for reagents that conform to the current specifications of the Committee on Analytical Reagents of the American Chemical Society.

Reporting Limit: (RL) The level at which method, permit, regulatory and client specific objectives are met. The reporting limit may never be lower than the statistically determined MDL, but may be higher based on any of the above considerations. Reporting limits are corrected for sample amounts, including the dry weight of solids, unless otherwise specified. Reporting limits are generally two times the MDL.

Representativeness: A quality element related to the ability to collect a sample reflecting the characteristics of the part of the environment to be assessed. Sample representativeness is dependent on the sampling techniques specified in the project work plan.

Sample Delivery Group: (SDG) A unit within a single project that is used to identify a group of samples for delivery. An SDG is a group of 20 or fewer field samples within a project, received over a period of up to 14 calendar days. Data from all samples in an SDG are reported concurrently. An SDG is generally defined by one of the following, whichever occurs first:

Samples may be assigned to SDGs by matrix (i.e., all soil samples in one SDG, all water samples in another), at the discretion of the laboratory. Clients may establish different SDG classifications to meet project specific requirements.

Sensitivity: The capability of a method or instrument to discriminate between measurement responses representing different levels (concentrations) of a variable of interest.

Standard: A substance or material, the properties of which are known with sufficient accuracy, to permit its use to evaluate the same property in a sample.

Standard Blank: A calibration standard consisting of the same solvent/reagent matrix used to prepare the calibration standards without the analytes. It is used to construct the calibration curve by establishing instrument background.

Standard Operating Procedure: (SOP) A written document which details the method of an operation, analysis, or action whose techniques and procedures are thoroughly prescribed and which is accepted as the method for performing certain routine or repetitive tasks.

Surrogates: A substance with properties that mimic the analyte of interest. It is unlikely to be found in environmental samples and is added to them for quality control purposes.

Systems Audit: An on-site inspection or assessment of a laboratory's quality system.

Traceability: The property of a result of a measurement whereby it can be related to appropriate standards, generally international or national standards, through an unbroken chain of comparisons.

Trip Blank: This blank is used to detect sample contamination from the container and preservative during transport and storage of the sample. A cleaned sample container is filled with laboratory pure water; any preservative used in the sample is added and then the blank is stored, shipped, and analyzed with its group of samples.

Validation: The process of substantiating specified performance criteria.

Verification: Confirmation by examination and provision of evidence that specified requirements for instruments have been met. The result of verification leads to a decision either to restore in service, to perform adjustment, to repair, to downgrade, or to declare obsolete. In all cases, it is required that a written trace of the verification performed shall be kept on the measuring instrument's individual record.

Warning Limits: The limits (typically 2 standard deviations either side of the mean) shown on a control chart within which most results are expected to lie (within a 95% probability) while the system remains in a state of statistical control.

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Pace Analytical Services, Inc
Export, PA

Addendum to

Pace Analytical Services, Inc
Quality Assurance/Quality Control
Policies and Procedures

December 2002
Revision 0

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December 2002
Revision 0

Pace Analytical Services, Inc
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Effective Date: Date of Last Signature

Randal T. [signature] 12/23/02

Quality Assurance Officer — Date

[signature] 12/19/02

General Manager — Date

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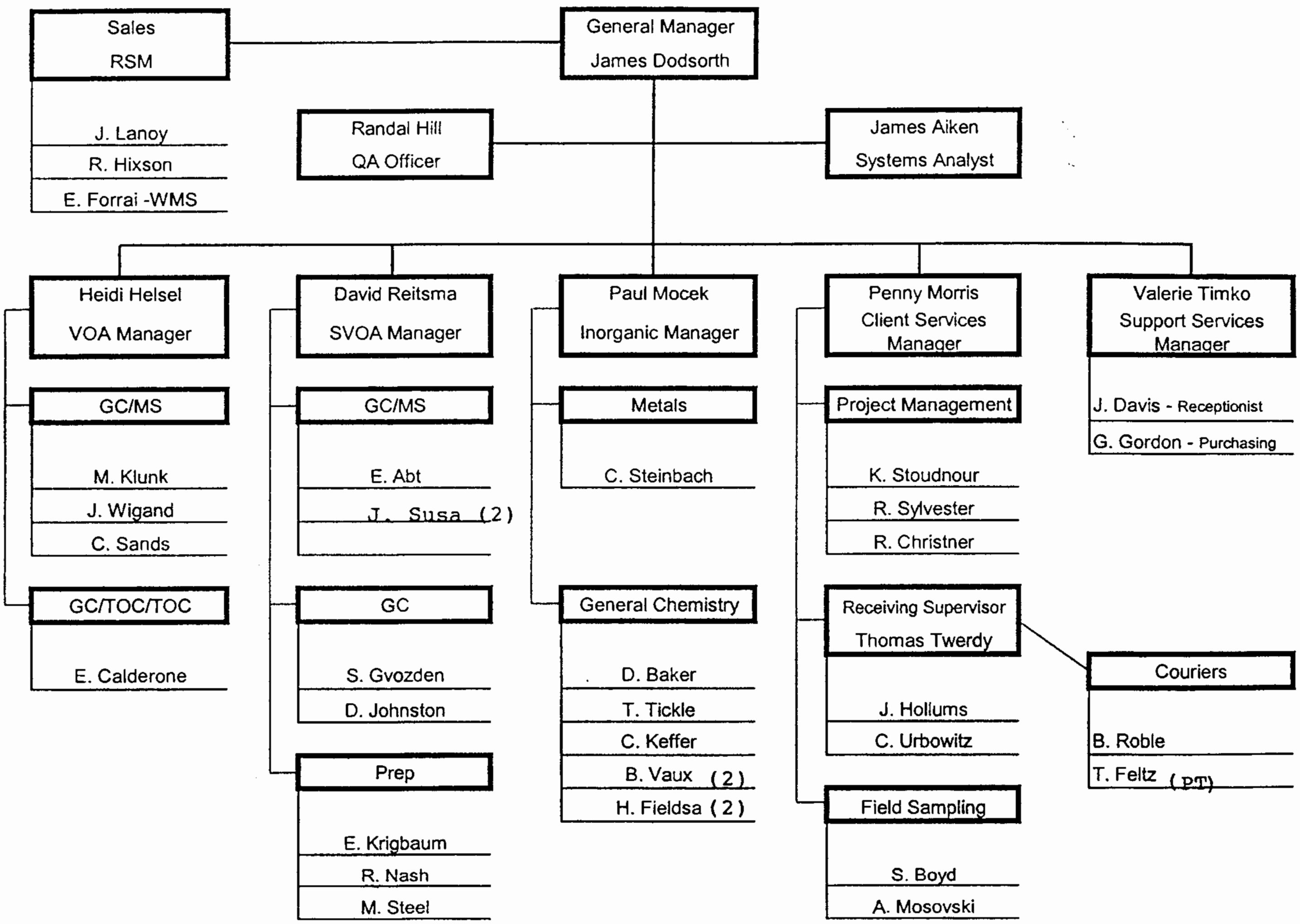
Purchase of Services

Procurement of Services are to be ordered and evaluated by personnel knowledgeable in the procedures, systems and/or equipment being serviced. The Purchase of Services are to be evaluated based upon the providers knowledge and experience, ability to do the work in the time line allotted, and cost.

- All laboratory personnel are authorized to purchase services. Supervisors and managers review the Purchase of Services as necessary.
- Where possible, services must be provided by personnel or vendors authorized by the manufacturer(s) of the procedure, system and/or equipment. Equipment and systems may be maintained by service providers under contract at the laboratory's discretion.
- Alternate providers of Services may be used provided they possess the same basic knowledge and experience to service the procedure, system and/or equipment. Alternate providers of Service must be approved by the laboratory supervisor and/or general manager.
- Any client or agency restrictions regarding the Purchase of Services must be observed by the laboratory personnel when ordering said services. (i.e. approved vendor lists, prior approval of subcontractors, etc).

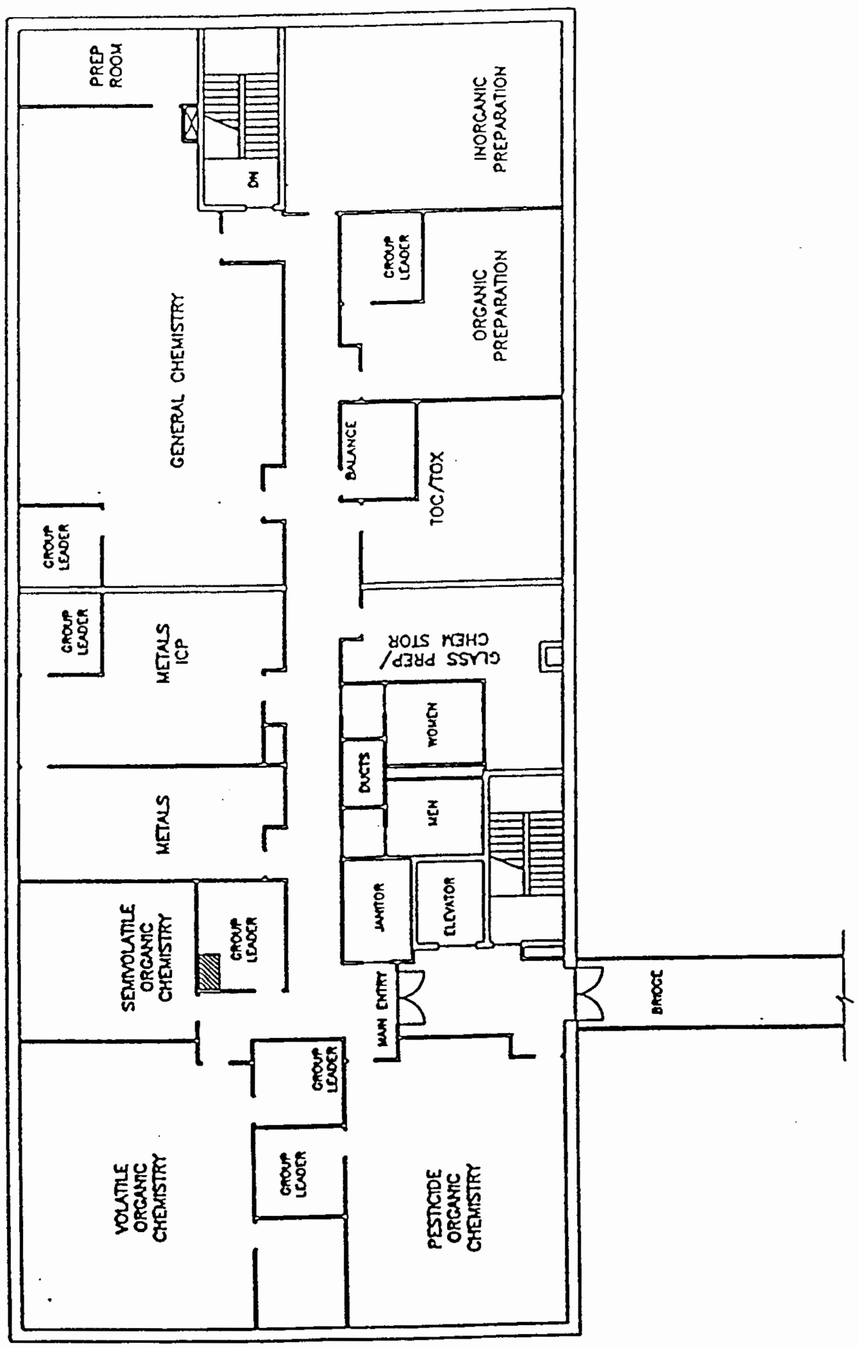
Pace Analytical Services, Inc
Export, PA
Organizational Chart



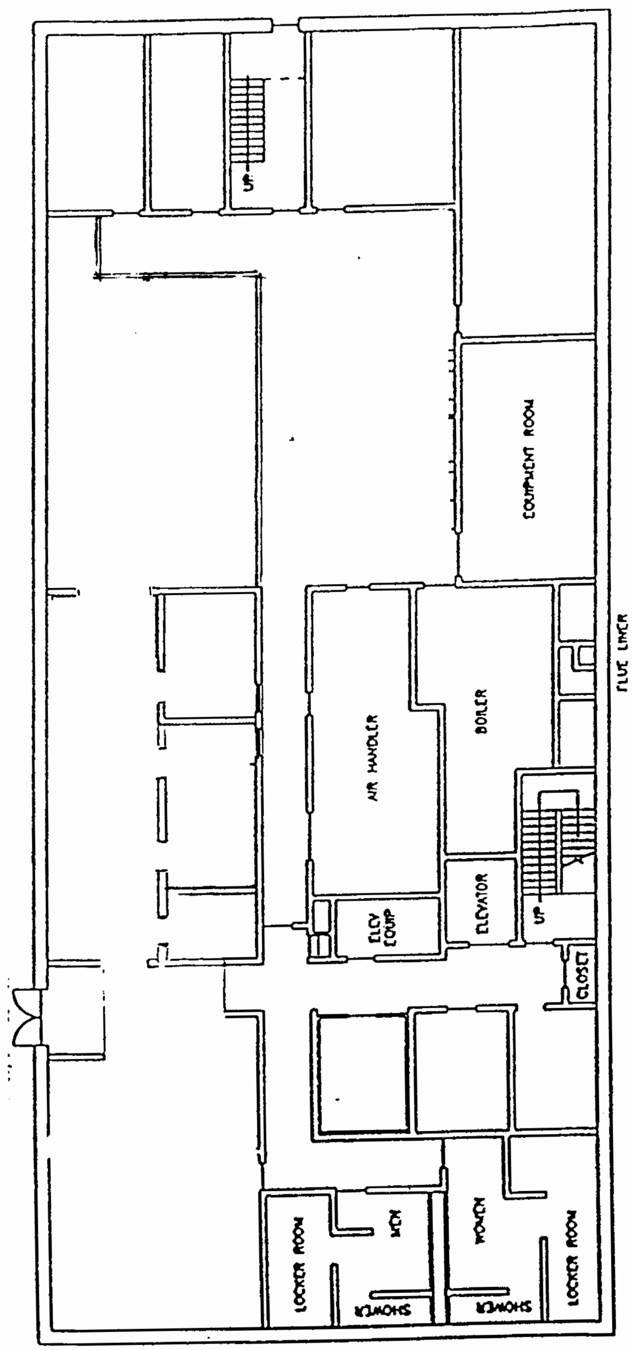
Equipment List - Pittsburgh Laboratory

INSTRUMENT TYPE QUANTITY	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	INSTRUM. LABEL	DETECTOR	ANALYSIS
GC/MS						
1	Hewlett-Packard	5970	2413A00688	M3	MSD	Semi-Vol
1	Hewlett-Packard	5973	US82321858	M5	MSD	Semi-Vol
1	Hewlett-Packard	5973	US01150089	M6	MSD	Semi-Vol
1	Hewlett-Packard	5973	US70820584	HPMS1	MSD	Volatiles
1	Hewlett-Packard	5973	US72821154	HPMS2	MSD	Volatiles
1	Hewlett-Packard	5973	US94223089	HPMS3	MSD	Volatiles
Gas Chromatographs						
1	Hewlett-Packard	5890A	2728A12992	GC A	Dual ECD	Pest/PCBs
1	Hewlett-Packard	5890A	2643A11529	GC-D	Dual ECD	PCBs
1	Hewlett-Packard	5890-Series II	3029A0193	GC G	Dual ECD	Herbicides
1	Hewlett-Packard	5890A	2541A06157	GC C	Dual FID	TPH-Diesel
1	Hewlett-Packard	5890-Series II	3108A34478	GC P	FID	Glycols/Alcohols
1	Hewlett-Packard	5890-Series II	3033A31116	VOA K	PID/FID	GC-Volatiles
1	Hewlett-Packard	5890A	2443A03237	VOA I	PID	GC-Volatiles
HPLC						
1	Waters	LC2/470/486	470-00727		UV/Fluor	PAH, Explosives
ICP						
1	Thermo Jarrell Ash	ICAP-61E	428690	TJA61E-T	PMT's	Trace ICP
Mercury Analyzer						
1	Leeman	PS-200 II	112-00031-1			Mercury
Automated Spectrophotometer						
1	Lachat	QuickChem 8000	A8300-1369		UV	Wet Chem
Total Organic Carbon						
1	OI	700	5329-400053			TOC
Total Organic Halide						
1	Mitsubishi	TOX-10	43C20335	TOX 1		TOX
1	Mitsubishi	TOX-10 Sigma	75C01692	TOX 2		TOX
Spectrophotometers						
1	Sequoia Turner	SP-850	1102010437561		UV	COD, MBAS
1	Milton-Roy	21D	3158100004		UV	CN
Infrared Spectrometer						
	Perkin Elmer	1310	132724			TPH
Solvent Extractio						
1	Dionex	ASE-200	99090116	ASE-200	n/a	Soil extractions

BUILDING 2 SECOND FLOOR



GROUND FLOOR PLAN
BUILDING NO. 2



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E87683
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Program CWA

Analyte	Method	Category	Certification Type	Effective Date
1,1,1-Trichloroethane	EPA 624	Volatile Organics	NELAP	2/13/2002
1,1,2,2-Tetrachloroethane	EPA 624	Volatile Organics	NELAP	2/13/2002
1,1,2-Trichloroethane	EPA 624	Volatile Organics	NELAP	2/13/2002
1,1-Dichloroethane	EPA 624	Volatile Organics	NELAP	2/13/2002
1,1-Dichloroethylene	EPA 624	Volatile Organics	NELAP	2/13/2002
1,2,4-Trichlorobenzene	EPA 625	Extractable Organics	NELAP	2/13/2002
1,2-Dichlorobenzene	EPA 624	Volatile Organics	NELAP	2/13/2002
1,2-Dichlorobenzene	EPA 625	Extractable Organics	NELAP	2/13/2002
1,2-Dichloroethane	EPA 624	Volatile Organics	NELAP	2/13/2002
1,2-Dichloropropane	EPA 624	Volatile Organics	NELAP	2/13/2002
1,3-Dichlorobenzene	EPA 624	Volatile Organics	NELAP	2/13/2002
1,3-Dichlorobenzene	EPA 625	Extractable Organics	NELAP	2/13/2002
1,4-Dichlorobenzene	EPA 624	Volatile Organics	NELAP	2/13/2002
1,4-Dichlorobenzene	EPA 625	Extractable Organics	NELAP	2/13/2002
2,4,5-T	EPA 615	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
2,4,6-Trichlorophenol	EPA 625	Extractable Organics	NELAP	2/13/2002
2,4-D	EPA 615	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
2,4-Dichlorophenol	EPA 625	Extractable Organics	NELAP	2/13/2002
2,4-Dimethylphenol	EPA 625	Extractable Organics	NELAP	2/13/2002
2,4-Dinitrophenol	EPA 625	Extractable Organics	NELAP	2/13/2002
2,4-Dinitrotoluene (2,4-DNT)	EPA 625	Extractable Organics	NELAP	2/13/2002
2,6-Dinitrotoluene (2,6-DNT)	EPA 625	Extractable Organics	NELAP	2/13/2002
2-Chloronaphthalene	EPA 625	Extractable Organics	NELAP	2/13/2002
2-Chlorophenol	EPA 625	Extractable Organics	NELAP	2/13/2002
2-Methyl-4,6-dinitrophenol	EPA 625	Extractable Organics	NELAP	2/13/2002
2-Nitrophenol	EPA 625	Extractable Organics	NELAP	2/13/2002
3,3'-Dichlorobenzidine	EPA 625	Extractable Organics	NELAP	2/13/2002
4,4'-DDD	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
4,4'-DDE	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
4,4'-DDT	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
4-Bromophenyl phenyl ether	EPA 625	Extractable Organics	NELAP	2/13/2002
4-Chloro-3-methylphenol	EPA 625	Extractable Organics	NELAP	2/13/2002
4-Chlorophenyl phenylether	EPA 625	Extractable Organics	NELAP	2/13/2002
4-Nitrophenol	EPA 625	Extractable Organics	NELAP	2/13/2002

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Acenaphthene	EPA 625	Extractable Organics	NELAP	2/13/2002
Acenaphthylene	EPA 625	Extractable Organics	NELAP	2/13/2002
Aldrin	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Aluminum	EPA 200.7	Metals	NELAP	2/13/2002
Anthracene	EPA 625	Extractable Organics	NELAP	2/13/2002
Antimony	EPA 200.7	Metals	NELAP	2/13/2002
Aroclor-1016 (PCB-1016)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Aroclor-1221 (PCB-1221)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Aroclor-1232 (PCB-1232)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Aroclor-1242 (PCB-1242)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Aroclor-1248 (PCB-1248)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Aroclor-1254 (PCB-1254)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Aroclor-1260 (PCB-1260)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Arsenic	EPA 200.7	Metals	NELAP	2/13/2002
Arsenic	EPA 6010	Metals	NELAP	2/13/2002
Barium	EPA 200.7	Metals	NELAP	2/13/2002
Benzene	EPA 624	Volatile Organics	NELAP	2/13/2002
Benzidine	EPA 625	Extractable Organics	NELAP	2/13/2002
Benzo(a)anthracene	EPA 625	Extractable Organics	NELAP	2/13/2002
Benzo(a)pyrene	EPA 625	Extractable Organics	NELAP	2/13/2002
Benzo(b)fluoranthene	EPA 625	Extractable Organics	NELAP	2/13/2002
Benzo(g,h,i)perylene	EPA 625	Extractable Organics	NELAP	2/13/2002
Benzo(k)fluoranthene	EPA 625	Extractable Organics	NELAP	2/13/2002
Beryllium	EPA 200.7	Metals	NELAP	2/13/2002
beta-BHC (beta-Hexachlorocyclohexane)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
bis(2-Chloroethoxy)methane	EPA 625	Extractable Organics	NELAP	2/13/2002
bis(2-Chloroethyl) ether	EPA 625	Extractable Organics	NELAP	2/13/2002
bis(2-Chloroisopropyl) ether	EPA 625	Extractable Organics	NELAP	2/13/2002
bis(2-Ethylhexyl) phthalate (DEHP)	EPA 625	Extractable Organics	NELAP	2/13/2002
Boron	EPA 200.7	Metals	NELAP	2/13/2002
Bromodichloromethane	EPA 624	Volatile Organics	NELAP	2/13/2002
Bromoform	EPA 624	Volatile Organics	NELAP	2/13/2002
Butyl benzyl phthalate	EPA 625	Extractable Organics	NELAP	2/13/2002

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Analyte	Method	Category	Certification Type	Effective Date
Cadmium	EPA 200.7	Metals	NELAP	2/13/2002
Cadmium	EPA 6010	Metals	NELAP	2/13/2002
Calcium	EPA 200.7	Metals	NELAP	2/13/2002
Carbon tetrachloride	EPA 624	Volatile Organics	NELAP	2/13/2002
Chlordane (tech.)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Chlorobenzene	EPA 624	Volatile Organics	NELAP	2/13/2002
Chloroethane	EPA 624	Volatile Organics	NELAP	2/13/2002
Chloroform	EPA 624	Volatile Organics	NELAP	2/13/2002
Chromium	EPA 200.7	Metals	NELAP	2/13/2002
Chromium	EPA 6010	Metals	NELAP	2/13/2002
Chrysene	EPA 625	Extractable Organics	NELAP	2/13/2002
cis-1,3-Dichloropropene	EPA 624	Volatile Organics	NELAP	2/13/2002
Cobalt	EPA 200.7	Metals	NELAP	2/13/2002
Copper	EPA 200.7	Metals	NELAP	2/13/2002
Copper	EPA 6010	Metals	NELAP	2/13/2002
Cyanide	EPA 335.2	General Chemistry	NELAP	2/13/2002
delta-BHC	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Dibenz(a,h) anthracene	EPA 625	Extractable Organics	NELAP	2/13/2002
Dibromochloromethane	EPA 624	Volatile Organics	NELAP	2/13/2002
Dieldrin	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Diethyl phthalate	EPA 625	Extractable Organics	NELAP	2/13/2002
Dimethyl phthalate	EPA 625	Extractable Organics	NELAP	2/13/2002
Di-n-butyl phthalate	EPA 625	Extractable Organics	NELAP	2/13/2002
Di-n-octyl phthalate	EPA 625	Extractable Organics	NELAP	2/13/2002
Endosulfan I	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Endosulfan II	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Endosulfan sulfate	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Endrin	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Endrin aldehyde	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Ethylbenzene	EPA 624	Volatile Organics	NELAP	2/13/2002
Fluoranthene	EPA 625	Extractable Organics	NELAP	2/13/2002
Fluorene	EPA 625	Extractable Organics	NELAP	2/13/2002
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Heptachlor	·EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002

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Analyte	Method	Category	Certification Type	Effective Date
Heptachlor epoxide	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Hexachlorobenzene	EPA 625	Extractable Organics	NELAP	2/13/2002
Hexachlorobutadiene	EPA 625	Extractable Organics	NELAP	2/13/2002
Hexachlorocyclopentadiene	EPA 625	Extractable Organics	NELAP	2/13/2002
Hexachloroethane	EPA 625	Extractable Organics	NELAP	2/13/2002
Indeno(1,2,3-cd)pyrene	EPA 625	Extractable Organics	NELAP	2/13/2002
Iron	EPA 200.7	Metals	NELAP	2/13/2002
Isophorone	EPA 625	Extractable Organics	NELAP	2/13/2002
Lead	EPA 200.7	Metals	NELAP	2/13/2002
Lead	EPA 6010	Metals	NELAP	2/13/2002
Magnesium	EPA 200.7	Metals	NELAP	2/13/2002
Manganese	EPA 200.7	Metals	NELAP	2/13/2002
Mercury	EPA 245.1	Metals	NELAP	2/13/2002
Mercury	EPA 7470	Metals	NELAP	2/13/2002
Mercury	EPA 7471	Metals	NELAP	2/13/2002
Methoxychlor	EPA 608.2	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Methyl bromide (Bromomethane)	EPA 624	Volatile Organics	NELAP	2/13/2002
Methyl chloride (Chloromethane)	EPA 624	Volatile Organics	NELAP	2/13/2002
Methylene chloride	EPA 624	Volatile Organics	NELAP	2/13/2002
Molybdenum	EPA 200.7	Metals	NELAP	2/13/2002
Molybdenum	EPA 6010	Metals	NELAP	2/13/2002
Naphthalene	EPA 625	Extractable Organics	NELAP	2/13/2002
Nickel	EPA 200.7	Metals	NELAP	2/13/2002
Nickel	EPA 6010	Metals	NELAP	2/13/2002
Nitrobenzene	EPA 625	Extractable Organics	NELAP	2/13/2002
n-Nitrosodimethylamine	EPA 625	Extractable Organics	NELAP	2/13/2002
n-Nitrosodi-n-propylamine	EPA 625	Extractable Organics	NELAP	2/13/2002
n-Nitrosodiphenylamine	EPA 625	Extractable Organics	NELAP	2/13/2002
Pentachlorophenol	EPA 625	Extractable Organics	NELAP	2/13/2002
pH	EPA 150.1	General Chemistry	NELAP	2/13/2002
Phenanthrene	EPA 625	Extractable Organics	NELAP	2/13/2002
Phenol	EPA 625	Extractable Organics	NELAP	2/13/2002
Potassium	EPA 200.7	Metals	NELAP	2/13/2002
Pyrene	EPA 625	Extractable Organics	NELAP	2/13/2002

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Analyte	Method	Category	Certification Type	Effective Date
Selenium	EPA 200.7	Metals	NELAP	2/13/2002
Selenium	EPA 6010	Metals	NELAP	2/13/2002
Silver	EPA 200.7	Metals	NELAP	2/13/2002
Silvex (2,4,5-TP)	EPA 615	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Sodium	EPA 200.7	Metals	NELAP	2/13/2002
Sulfide	EPA 376.2	General Chemistry	NELAP	2/13/2002
Tetrachloroethylene (Perchloroethylene)	EPA 624	Volatile Organics	NELAP	2/13/2002
Thallium	EPA 200.7	Metals	NELAP	2/13/2002
Titanium	EPA 200.7	Metals	NELAP	2/13/2002
Toluene	EPA 624	Volatile Organics	NELAP	2/13/2002
Total Petroleum Hydrocarbons (TPH)	EPA 418.1	General Chemistry	NELAP	2/13/2002
Toxaphene (Chlorinated camphene)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
trans-1,2-Dichloroethylene	EPA 624	Volatile Organics	NELAP	2/13/2002
trans-1,3-Dichloropropylene	EPA 624	Volatile Organics	NELAP	2/13/2002
Trichloroethene (Trichloroethylene)	EPA 624	Volatile Organics	NELAP	2/13/2002
Vanadium	EPA 200.7	Metals	NELAP	2/13/2002
Vinyl chloride	EPA 624	Volatile Organics	NELAP	2/13/2002
Xylene (total)	EPA 624	Volatile Organics	NELAP	2/13/2002
Zinc	EPA 200.7	Metals	NELAP	2/13/2002
Zinc	EPA 6010	Metals	NELAP	2/13/2002

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Program RCRA/CERCLA

Analyte	Method	Category	Certification Type	Effective Date
1,1,1-Trichloroethane	EPA 8260	Volatile Organics	NELAP	2/13/2002
1,1,2,2-Tetrachloroethane	EPA 8260	Volatile Organics	NELAP	2/13/2002
1,1,2-Trichloroethane	EPA 8260	Volatile Organics	NELAP	2/13/2002
1,1-Dichloroethane	EPA 8260	Volatile Organics	NELAP	2/13/2002
1,1-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	2/13/2002
1,2,4-Trichlorobenzene	EPA 8270	Extractable Organics	NELAP	2/13/2002
1,2-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	2/13/2002
1,2-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	2/13/2002
1,2-Dichloroethane	EPA 8260	Volatile Organics	NELAP	2/13/2002
1,2-Dichloropropane	EPA 8260	Volatile Organics	NELAP	2/13/2002
1,3-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	2/13/2002
1,3-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	2/13/2002
1,4-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	2/13/2002
1,4-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	2/13/2002
2,4,5-T	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
2,4,5-Trichlorophenol	EPA 8270	Extractable Organics	NELAP	2/13/2002
2,4,6-Trichlorophenol	EPA 8270	Extractable Organics	NELAP	2/13/2002
2,4-D	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
2,4-Dichlorophenol	EPA 8270	Extractable Organics	NELAP	2/13/2002
2,4-Dimethylphenol	EPA 8270	Extractable Organics	NELAP	2/13/2002
2,4-Dinitrophenol	EPA 8270	Extractable Organics	NELAP	2/13/2002
2,4-Dinitrotoluene (2,4-DNT)	EPA 8270	Extractable Organics	NELAP	2/13/2002
2,6-Dinitrotoluene (2,6-DNT)	EPA 8270	Extractable Organics	NELAP	2/13/2002
2-Butanone (Methyl ethyl ketone, MEK)	EPA 8260	Volatile Organics	NELAP	2/13/2002
2-Chloronaphthalene	EPA 8270	Extractable Organics	NELAP	2/13/2002
2-Chlorophenol	EPA 8270	Extractable Organics	NELAP	2/13/2002
2-Hexanone	EPA 8260	Volatile Organics	NELAP	2/13/2002
2-Methyl-4,6-dinitrophenol	EPA 8270	Extractable Organics	NELAP	2/13/2002
2-Methylnaphthalene	EPA 8270	Extractable Organics	NELAP	2/13/2002
2-Methylphenol (o-Cresol)	EPA 8270	Extractable Organics	NELAP	2/13/2002
2-Nitroaniline	EPA 8270	Extractable Organics	NELAP	2/13/2002
2-Nitrophenol	EPA 8270	Extractable Organics	NELAP	2/13/2002
3,3'-Dichlorobenzidine	EPA 8270	Extractable Organics	NELAP	2/13/2002
3-Methylphenol (m-Cresol)	EPA 8270	Extractable Organics	NELAP	2/13/2002

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Analyte	Method	Category	Certification Type	Effective Date
3-Nitroaniline	EPA 8270	Extractable Organics	NELAP	2/13/2002
4,4'-DDD	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
4,4'-DDD	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
4,4'-DDE	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
4,4'-DDE	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
4,4'-DDT	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
4,4'-DDT	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
4-Bromophenyl phenyl ether	EPA 8270	Extractable Organics	NELAP	2/13/2002
4-Chloro-3-methylphenol	EPA 8270	Extractable Organics	NELAP	2/13/2002
4-Chloroaniline	EPA 8270	Extractable Organics	NELAP	2/13/2002
4-Chlorophenyl phenylether	EPA 8270	Extractable Organics	NELAP	2/13/2002
4-Methyl-2-pentanone (MIBK)	EPA 8260	Volatile Organics	NELAP	2/13/2002
4-Methylphenol (p-Cresol)	EPA 8270	Extractable Organics	NELAP	2/13/2002
4-Nitroaniline	EPA 8270	Extractable Organics	NELAP	2/13/2002
4-Nitrophenol	EPA 8270	Extractable Organics	NELAP	2/13/2002
Acenaphthene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Acenaphthene	EPA 8310	Extractable Organics	NELAP	2/13/2002
Acenaphthylene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Acenaphthylene	EPA 8310	Extractable Organics	NELAP	2/13/2002
Acetone	EPA 8260	Volatile Organics	NELAP	2/13/2002
Acetophenone	EPA 8270	Extractable Organics	NELAP	2/13/2002
Aldrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
alpha-Chlordane	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Aluminum	EPA 6010	Metals	NELAP	2/13/2002
Aniline	EPA 8270	Extractable Organics	NELAP	2/13/2002
Anthracene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Anthracene	EPA 8310	Extractable Organics	NELAP	2/13/2002
Antimony	EPA 6010	Metals	NELAP	2/13/2002
Aroclor-1016 (PCB-1016)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Aroclor-1221 (PCB-1221)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Aroclor-1232 (PCB-1232)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Aroclor-1242 (PCB-1242)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	2/13/2002

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Aroclor-1248 (PCB-1248)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Aroclor-1254 (PCB-1254)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Aroclor-1260 (PCB-1260)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Arsenic	EPA 6010	Metals	NELAP	2/13/2002
Barium	EPA 6010	Metals	NELAP	2/13/2002
Benzene	EPA 8021	Volatile Organics	NELAP	2/13/2002
Benzene	EPA 8260	Volatile Organics	NELAP	2/13/2002
Benzo(a)anthracene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Benzo(a)anthracene	EPA 8310	Extractable Organics	NELAP	2/13/2002
Benzo(a)pyrene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Benzo(a)pyrene	EPA 8310	Extractable Organics	NELAP	2/13/2002
Benzo(b)fluoranthene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Benzo(b)fluoranthene	EPA 8310	Extractable Organics	NELAP	2/13/2002
Benzo(g,h,i)perylene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Benzo(g,h,i)perylene	EPA 8310	Extractable Organics	NELAP	2/13/2002
Benzo(k)fluoranthene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Benzo(k)fluoranthene	EPA 8310	Extractable Organics	NELAP	2/13/2002
Beryllium	EPA 6010	Metals	NELAP	2/13/2002
beta-BHC (beta-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
beta-BHC (beta-Hexachlorocyclohexane)	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
bis(2-Chloroethoxy)methane	EPA 8270	Extractable Organics	NELAP	2/13/2002
bis(2-Chloroethyl) ether	EPA 8270	Extractable Organics	NELAP	2/13/2002
bis(2-Chloroisopropyl) ether	EPA 8270	Extractable Organics	NELAP	2/13/2002
bis(2-Ethylhexyl) phthalate (DEHP)	EPA 8270	Extractable Organics	NELAP	2/13/2002
Boron	EPA 6010	Metals	NELAP	2/13/2002
Bromochloromethane	EPA 8260	Volatile Organics	NELAP	2/13/2002
Bromodichloromethane	EPA 8260	Volatile Organics	NELAP	2/13/2002
Bromoform	EPA 8260	Volatile Organics	NELAP	2/13/2002
Butyl benzyl phthalate	EPA 8270	Extractable Organics	NELAP	2/13/2002
Cadmium	EPA 6010	Metals	NELAP	2/13/2002
Calcium	EPA 6010	Metals	NELAP	2/13/2002
Carbazole	EPA 8270	Extractable Organics	NELAP	2/13/2002
Carbon disulfide	EPA 8260	Volatile Organics	NELAP	2/13/2002
Carbon tetrachloride	EPA 8260	Volatile Organics	NELAP	2/13/2002

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Chlordane (tech.)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Chlorobenzene	EPA 8260	Volatile Organics	NELAP	2/13/2002
Chloroethane	EPA 8260	Volatile Organics	NELAP	2/13/2002
Chloroform	EPA 8260	Volatile Organics	NELAP	2/13/2002
Chromium	EPA 6010	Metals	NELAP	2/13/2002
Chrysene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Chrysene	EPA 8310	Extractable Organics	NELAP	2/13/2002
cis-1,2-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	2/13/2002
cis-1,3-Dichloropropene	EPA 8260	Volatile Organics	NELAP	2/13/2002
Cobalt	EPA 6010	Metals	NELAP	2/13/2002
Copper	EPA 6010	Metals	NELAP	2/13/2002
Corrosivity (pH)	EPA 9040	General Chemistry	NELAP	2/13/2002
delta-BHC	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
delta-BHC	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Dibenz(a,h) anthracene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Dibenz(a,h) anthracene	EPA 8310	Extractable Organics	NELAP	2/13/2002
Dibenzofuran	EPA 8270	Extractable Organics	NELAP	2/13/2002
Dibromochloromethane	EPA 8260	Volatile Organics	NELAP	2/13/2002
Dieldrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Diethyl phthalate	EPA 8270	Extractable Organics	NELAP	2/13/2002
Dimethyl phthalate	EPA 8270	Extractable Organics	NELAP	2/13/2002
Di-n-butyl phthalate	EPA 8270	Extractable Organics	NELAP	2/13/2002
Di-n-octyl phthalate	EPA 8270	Extractable Organics	NELAP	2/13/2002
Endosulfan I	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Endosulfan I	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Endosulfan II	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Endosulfan sulfate	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Endrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Endrin aldehyde	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Endrin ketone	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Ethylbenzene	EPA 8021	Volatile Organics	NELAP	2/13/2002
Ethylbenzene	EPA 8260	Volatile Organics	NELAP	2/13/2002
Extractable organics halides (EOX)	EPA 9023	General Chemistry	NELAP	2/13/2002
Fluoranthene	EPA 8270	Extractable Organics	NELAP	2/13/2002

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Analyte	Method	Category	Certification Type	Effective Date
Fluoranthene	EPA 8310	Extractable Organics	NELAP	2/13/2002
Fluorene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Fluorene	EPA 8310	Extractable Organics	NELAP	2/13/2002
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
gamma-Chlordane	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Heptachlor	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Heptachlor	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Heptachlor epoxide	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Heptachlor epoxide	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Hexachlorobenzene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Hexachlorobutadiene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Hexachlorocyclopentadiene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Hexachloroethane	EPA 8270	Extractable Organics	NELAP	2/13/2002
Ignitability	EPA 1010	General Chemistry	NELAP	2/13/2002
Indeno(1,2,3-cd)pyrene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Indeno(1,2,3-cd)pyrene	EPA 8310	Extractable Organics	NELAP	2/13/2002
Iron	EPA 6010	Metals	NELAP	2/13/2002
Isophorone	EPA 8270	Extractable Organics	NELAP	2/13/2002
Isopropylbenzene	EPA 8260	Volatile Organics	NELAP	2/13/2002
Lead	EPA 6010	Metals	NELAP	2/13/2002
Lithium	EPA 6010	Metals	NELAP	2/13/2002
Magnesium	EPA 6010	Metals	NELAP	2/13/2002
Manganese	EPA 6010	Metals	NELAP	2/13/2002
Mercury	EPA 7470	Metals	NELAP	2/13/2002
Mercury	EPA 7471	Metals	NELAP	2/13/2002
Methoxychlor	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Methyl bromide (Bromomethane)	EPA 8260	Volatile Organics	NELAP	2/13/2002
Methyl chloride (Chloromethane)	EPA 8260	Volatile Organics	NELAP	2/13/2002
Methyl tert-butyl ether (MTBE)	EPA 8260	Volatile Organics	NELAP	2/13/2002
Methylene chloride	EPA 8260	Volatile Organics	NELAP	2/13/2002
Molybdenum	EPA 6010	Metals	NELAP	2/13/2002
Naphthalene	EPA 8021	Volatile Organics	NELAP	2/13/2002
Naphthalene	EPA 8260	Volatile Organics	NELAP	2/13/2002

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Naphthalene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Naphthalene	EPA 8310	Extractable Organics	NELAP	2/13/2002
Nickel	EPA 6010	Metals	NELAP	2/13/2002
Nitrobenzene	EPA 8270	Extractable Organics	NELAP	2/13/2002
n-Nitrosodi-n-propylamine	EPA 8270	Extractable Organics	NELAP	2/13/2002
n-Nitrosodiphenylamine	EPA 8270	Extractable Organics	NELAP	2/13/2002
Paint Filter Liquids Test	EPA 9095	General Chemistry	NELAP	2/13/2002
Pentachlorophenol	EPA 8270	Extractable Organics	NELAP	2/13/2002
pH	EPA 9040	General Chemistry	NELAP	2/13/2002
pH	EPA 9045	General Chemistry	NELAP	2/13/2002
Phenanthrene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Phenanthrene	EPA 8310	Extractable Organics	NELAP	2/13/2002
Phenol	EPA 8270	Extractable Organics	NELAP	2/13/2002
Potassium	EPA 6010	Metals	NELAP	2/13/2002
Pyrene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Pyrene	EPA 8310	Extractable Organics	NELAP	2/13/2002
Pyridine	EPA 8270	Extractable Organics	NELAP	2/13/2002
Reactive cyanide	Sec. 7.3 SW-846	General Chemistry	NELAP	2/13/2002
Reactive sulfide	Sec. 7.3 SW-846	General Chemistry	NELAP	2/13/2002
Selenium	EPA 6010	Metals	NELAP	2/13/2002
Silver	EPA 6010	Metals	NELAP	2/13/2002
Silvex (2,4,5-TP)	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Sodium	EPA 6010	Metals	NELAP	2/13/2002
Strontium	EPA 6010	Metals	NELAP	2/13/2002
Styrene	EPA 8260	Volatile Organics	NELAP	2/13/2002
Sulfide	EPA 9030/9034	General Chemistry	NELAP	2/13/2002
Synthetic Precipitation Leaching Procedure	EPA 1312	General Chemistry	NELAP	2/13/2002
Tetrachloroethylene (Perchloroethylene)	EPA 8260	Volatile Organics	NELAP	2/13/2002
Thallium	EPA 6010	Metals	NELAP	2/13/2002
Toluene	EPA 8021	Volatile Organics	NELAP	2/13/2002
Toluene	EPA 8260	Volatile Organics	NELAP	2/13/2002
Total cyanide	EPA 9010/9012	General Chemistry	NELAP	2/13/2002
Total organic carbon	EPA 9060	General Chemistry	NELAP	2/13/2002
Total organic halides (TOX)	EPA 9020	General Chemistry	NELAP	2/13/2002

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Toxaphene (Chlorinated camphene)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Toxicity Characteristic Leaching Procedure	EPA 1311	General Chemistry	NELAP	2/13/2002
trans-1,2-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	2/13/2002
trans-1,3-Dichloropropylene	EPA 8260	Volatile Organics	NELAP	2/13/2002
Trichloroethene (Trichloroethylene)	EPA 8260	Volatile Organics	NELAP	2/13/2002
Vanadium	EPA 6010	Metals	NELAP	2/13/2002
Vinyl chloride	EPA 8260	Volatile Organics	NELAP	2/13/2002
Xylene (total)	EPA 8021	Volatile Organics	NELAP	2/13/2002
Xylene (total)	EPA 8260	Volatile Organics	NELAP	2/13/2002
Zinc	EPA 6010	Metals	NELAP	2/13/2002

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